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THE IRON TRADE REVIEW

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More Buying by Railroads

And Agricultural Implement Makers Are Busy—Other Consumers Show Very Little Activity

The first half of the year closes with many hopes not realized and positive indications of early prosperity are lacking. But nature is doing its part magnificently and there is a growing belief that with the great crops of the year assured, decided improvement is bound to come, if a fair advance in railroad rates is granted and if Congress can be persuaded to eliminate the worst features of pending legislation and go home.

Pig Iron

Sales of pig iron continue to be disappointing. While in some districts sales were of larger tonnage in June than in the preceding month, prices have not improved and softening continues. In the south, $10 can be done without much difficulty on No. 2 foundry for prompt delivery, but after some sales at $10 for third quarter, furnaces are holding for $10.25 for third quarter and $10.50 for the last quarter. Sales of from 7,000 to 8,000 tons of malleable and 4,000 of foundry grades are the principal transactions of lower lake furnaces.

Railroad Buying

Orders for rails and cars placed during June were the largest for a number of months. The principal tonnage in rails was that for the Pennsylvania, amounting to 137,000, of which 27,000 had already gone to the mills. June car orders amount to about 16,500, the largest number of any month this year. The New York Central lines have increased their car order to 8,400 and are still figuring on 1,000 box and 1,000 gondola cars.

Contracts for subway and elevated extensions in New York City awarded to date amount to over 400,000 tons, of which 300,000 tons have been taken by the American Bridge Co. and the remainder by independents. About 200,000 tons are not yet placed. The Illinois Central is asking for bids for the bridge at Paducah, Ky., connecting Kentucky and Illinois, requiring about 20,000 tons.

Sheets

The signing of the Amalgamated scale by the Brier Hill Steel Co. and the announcement that other companies are ready to take the same action indicate that there will not be a very serious controversy. Many mills will, however, be closed for a time.

Bars

Agricultural implement manufacturers are still making vigorous efforts to contract for the year's requirements at very low prices, but mills are showing considerable firmness and are not quoting 1.10c, Pittsburgh, on anything except prompt business. An effort at Toledo to shade the 1.10c, Pittsburgh, price on 700 tons of steel bars for prompt shipment failed and the buyer announces that he will order bar iron.

Cotton Ties

The announcement of the opening of the cotton tie market for this year at 65 cents per bundle is received with more than the usual interest because it has been understood for some time that British and Belgium cotton tie makers were eager to compete for the American market. Some cotton ties of English make have been held in New Orleans warehouses for several years, awaiting an advance in prices. This year's price is, however, the lowest in many years. The cotton crop will require from 70,000 to 75,000 tons of ties, of which probably 50,000 tons will be manufactured in the Pittsburgh district.

THE OPEN HEARTH

Write to Your Senators

NO ONE will dispute the assertion of President Wilson that business has been in a feverish and apprehensive condition in this country for more than 10 years, and all will agree that uncertainty has a depressing effect.

But nothing is settled until it is settled right.

If all perplexing problems could be settled in the right way this summer, it would be folly to refuse to do so. If, however, in place of the present uncertainty, we are to have the certainty of worse conditions, the action of Congress will, of course, be disastrous.

The tariff question was "settled" by passing a radical bill, and to say that the less than nine months since the bill was put upon the statute books has demonstrated that the new tariff will be a blessing to the country, is preposterous. The President says that when the tariff bill was passed, business shivered, but that later it was found that re-adjustment was possible without any serious disturbance. A good many people are of the opinion that the water today, even in mid-summer, is pretty cold and is likely to be a great deal colder when winter comes. We may have a taste of "psychology" below zero, with business frozen.

As to the currency legislation, we are glad to say that the results are most promising. This, we believe, is the very best legislation that has been enacted by the present Congress. We hope that the greatest expectations for its success will be realized. It is, however, too early to be certain on this point.

Rashly assuming that in passing the tariff and currency legislation, business prosperity has been assured to as great an extent as legislation on those two important subjects could assure it, President Wilson then declares that but one act remains to give business its "constitution of freedom"—that is, the carrying out of the trust program. He says that after the passage of the anti-trust bills, "there will be a boom of business in this country such as we have never witnessed in the United States." We believe that even with the low tariff and the uncertainty as to the currency law, there might be reason for hoping for business prosperity, if the country could have a rest from further legislation or if sound anti-trust laws could be passed promptly, but with the enactment of such a measure as the Clayton bill and various obnoxious features of the trade commission bill, business would again be given cold shivers. No measure which legalizes the boycott, encourages lawlessness and confers special favors upon two classes, as does the Clayton bill, can be considered a part of a permanent settlement of business problems.

THE IRON TRADE REVIEW has advocated delay because we have not believed that it was at all probable that wise legislation could be obtained this summer. The President is, however, determined to keep Congress in session and we believe that business men should exercise all the influence they can command to have pending bills, particularly the Clayton bill, amended.

The outlook is not hopeless. In fact, as our Washington correspondent indicates, there is an excellent chance of eliminating some of the most objectionable features of the pending bills. Senator Pomerene, of Ohio, has come out openly in opposition to the clause of the Clayton bill which eliminates labor unions and farmers' organizations from prosecution under the Sherman anti-trust law. He had the courage to do this in a telegram to officials of a railwaymen's union. All honor to him for this declaration. We believe that other Senators can be successfully appealed to, if business men will express themselves forcibly and with full knowledge in regard to the facts.

Write to your Senators about these bills.

The Cincinnati "Pocket"

MUCH surprise has frequently been expressed recently because more pig iron is not being sold at this time of the year in the Cincinnati district. The end of the first half, at which time contracts usually expire, is at hand, and inquiries are sent out for requirements to cover the next six months. Increased demand in proportion to former years, however, has not come out in Cincinnati

THE OPEN HEARTH

territory, although in surrounding districts, especially throughout the south, it has been more satisfactory than for months. Pig iron producers have been making close investigations recently in an effort to discover why Cincinnati is in this "pocket" of inactivity and to locate the reason why the territory in and around Cincinnati proper is the last to show a slight revival in buying.

The explanation is simply that melters throughout southern Ohio and Indiana do not need any iron. In a number of cases, large users have been running so far below normal capacity during the first half that iron purchased for that delivery will run them well into the second half, and with the market rather uncertain as to future prices, they are showing an inclination to postpone going any further until requirements actually demand. Numerous other users are also buying in small lots at frequent intervals rather than to contract very far ahead under present conditions, making the market appear more dull than it really is, as such sales generally pass unnoticed. Also numerous transactions are being made in a very secret manner, and as they are never heard of, they do not tend to improve the general appearance of the situation.

Shall the Boycott be Legalized?

THE legalizing of the boycott as provided for by the Clayton bill, which recently passed the House, is one of the most objectionable features of that measure. Not content with providing, as originally contemplated, that no restraining order or injunction should be issued to prohibit any persons from ceasing to patronize or to employ any party to a labor dispute, or from recommending, advising or persuading others by peaceful means so to do, a clause was added to the original section to this effect: "Nor shall any of the acts specified in this paragraph be considered or held unlawful". In other words, no court shall decide that a boycott is unlawful.

Ex-President Taft, when he was a federal judge, in deciding a case against the Cincinnati Railway Co., said that the distinction between an ordinary, lawful and peaceful strike entered upon to obtain concessions in the terms of the strikers' employment, and a boycott is not a fanciful one, or one which needs the power of fine distinction to determine which is which. Judge Taft added that every laboring man recognizes the one or the other as clearly as the lawyer or the judge. This is true, but at the same time it is well to emphasize the fact that there is a distinct difference between quitting employment and engaging in a boycott. When a union uses its power to attempt to drive a man out of business, it is engaging in a boycott, which in numerous court decisions has been declared unlawful. Justice Harlan, in deciding a famous case in the Supreme Court of the United States in which the defendants sought to prevent certain persons from pursuing their calling as musicians, said that a conspiracy such as was charged was an offense of a grave character. In a California suit, growing out of the Danbury hatters' case, the court held that even when there was no evidence of force, threat or intimidation, the acts of combined numbers endeavoring to drive a man out of business were unlawful. In a case passed upon by the New York Supreme Court, Judge Blackmar declared that a combination to attack a man's good-will is illegal and the illegality is not changed by the innocence of the means used.

By a few words, as above quoted, the Clayton bill proposes to prevent any court from declaring a boycott illegal. So long as the acts in themselves are not criminal, the boycott may proceed and any amount of damage can be done. It seems hardly possible that the Senate of the United States will pass a bill which legalizes the boycott, but when it is remembered that this bill was passed by the House of Representatives by a record vote of 277 for and 11 others paired in its favor, and only 54 against with 11 paired against the bill, it is clear that the labor unions dominated all but a handful of the members of the lower branch of Congress.

It is not safe to take any chances with the Senate. Hence we believe that manufacturers and business men generally everywhere should write to their senators and vigorously protest against the legalization of the boycott and give reasons of their own for trying to pass the Clayton bill. Many could strengthen their protests by relating their personal experience with boycotts.

Prices Present and Past

Quotations on leading products today, average for last month, average for three months ago and average for July, 1913. Prices are those ruling in the largest percentage of sales at the dates named.

	Today's prices.	Average for June, 1914.	Average for April, 1914.	Average for July, 1913.
Bessemer pig iron, Pittsburgh..	$14.90	$14.90	$14.90	$16.65
Basic pig iron, Pittsburgh.....	13.90	13.90	13.90	15.07
No. 2 Fdy. pig iron, Pittsburgh	13.90	13.90	14.15	14.71
Northern No. 2 Fdy., Chgo....	14.00	14.25	14.25	15.00
Lake Superior Charcoal, Chgo..	16.00	15.75	15.50	16.75
Malleable Bessemer, Chicago...	14.00	14.25	14.25	14.85
Southern No. 2, Birmingham...	10.25	10.37	10.43	10.45
Southern Ohio No. 2, Ironton..	13.25	13.50	13.50	14.20
Basic, eastern Pa.....	14.00	14.00	14.25	15.25
No. 2X Virginia furnace.....	12.75	12.75	12.75	13.00
No. 2X Foundry, Philadelphia.	14.75	14.75	15.00	15.50
Ferro manganese, Baltimore....	38.00	38.00	38.50	58.50
Bessemer billets, Pbgh. & Ygn..	19.50	19.75	20.80	26.12
Op. h'th billets, Pbgh. & Ygn..	19.50	19.75	20.80	26.12
Bess. sheet bars, Pbgh. & Ygn..	20.50	20.75	21.60	27.12
Op. h'th sh. bars, Pbgh. & Ygn.	20.50	20.75	21.60	27.12
Steel bars, Pittsburgh.....	1.10	1.11½	1.20	1.40
Iron bars, Philadelphia.....	1.17	1.17	1.22	1.47
Steel bars, Chicago.....	1.28	1.29	1.38	1.58
Tank plates, Chicago.....	1.28	1.28	1.32	1.63

	Today's prices.	Average for June, 1914.	Average for April, 1914.	Average for July, 1913.
Structural shapes, Chicago.....	$1.28	$1.28	$1.35	$1.63
Iron bars, Cleveland, local del'y	1.20	1.20	1.25	1.56
Iron bars, Chgo. mill.....	1.05	1.10	1.15	1.50
Beams, Pittsburgh	1.10	1.11½	1.18	1.45
Beams, Philadelphia	1.25	1.25	1.30	1.60
Tank plates, Pittsburgh.....	1.10	1.10	1.15	1.44
Tank plates, Philadelphia.....	1.25	1.25	1.30	1.65
Sheets, blk., No. 28, Pittsburgh	1.80	1.82	1.92	2.20
Sheets, blue an., No. 10, Pbgh..	1.35	1.35	1.40	1.65
Sheets, galv., No. 28, Pbgh....	2.75	2.80	2.92	3.25
Wire nails, Pittsburgh.....	1.50	1.50	1.60	1.66
Connellsville fur. coke, contr...	1.85	1.75	2.00	2.85
Connellsville fdy. coke contr....	2.40	2.35	2.50	3.00
Heavy melting steel, Pbgh.....	12.00	12.00	12.00	12.50
Heavy melting steel, east'n Pa..	10.75	10.75	11.00	11.50
Heavy melting steel, Chgo.....	9.50	9.75	9.50	10.50
Heavy cast, eastern Pa.....	12.50	12.50	13.00	13.25
No. 1 wrought, eastern Pa.....	12.50	12.50	13.00	14.25
No. 1 wrought, Chgo.....	9.00	8.88	8.50	10.50
Rerolling rails, Chgo.....	11.25	11.25	11.25	12.00
Car wheels, Chgo.....	10.75	11.25	11.00	17.00

(For Additional Prices See Page 48.)

Pig Iron Sales Are Disappointing

In Eastern Pennsylvania and the Demand is Sluggish in Nearly All Parts of the Country—Southern Iron Lower

Disappointment at the course of the iron market remains pronounced among makers and sellers in eastern Pennsylvania. While the June volume of sales was considerably ahead of May, some sellers reporting having doubled their bookings, prices have not responded; in fact, are slightly softer, if anything. The current run of business remains as it has been recently, neither good nor bad. A Salem, N. J., buyer bought 1,500 tons of eastern Pennsylvania No. 2 plain additional obtaining part at about $14.50 delivered and the remainder at the very low figure of $14.10 delivered. This makes the company's full purchase about 2,500 tons. A Hainesport, N. J., buyer took 500 tons of No. 2 plain; a Reading textile machinery builder 500 tons of Virginia No. 2X and scattered lots foot up considerable tonnage. Among the week's sales were 1,200 tons of charcoal iron. Virginia iron has been moving more freely in smaller lots and sales total several thousand. On most of these, the full price of $12.75 furnace for No. 2X was obtained, but in some cases this figure is being shaded. A Virginia pipe maker is buying additional iron. Northern No. 2X hangs about $14.75, Philadelphia. Sales over that figure now are scarce and in instances it has been slightly cut. One buyer in this district is figuring on 2,000 tons of iron. Delaware River pipe makers continue to carry on some negotiations. The General Electric Co. is understood to have placed about 2,500 tons of low phosphorus iron for Everett & Lynn with Lebanon makers. A local buyer continues to figure on 3,000 to 4,000 tons of low phosphorus and 2,000 to 3,000 tons of Bessemer. A Harrisburg buyer has taken 5,000 tons of basic for shipment over the last half from several producers at $14.50 delivered, which is an advance of 50 cents over the last basic sale in that territory. Some special conditions surround the transaction however.

In the immediate Cleveland district, the pig iron market is exceedingly dull, but one of the Cleveland agencies has sold 7,000 to 8,000 tons of malleable and 4,000 tons of foundry iron. For delivery in the Cleveland district, the prevailing quotation is now $14.25, delivered this month, and $13.75 for the remainder of the year.

Sanitary Company Buys

The Standard Sanitary Mfg. Co., Pittsburgh, made the largest purchase of pig iron in the entire Pittsburgh district, closing for a total of 8,000 tons the latter part of last week. Of this total, 5,000 tons were northern No. 2 foundry iron and 3,000 tons southern No. 2 and 3. It is understood this aggregate is only a portion of the third quarter requirements of the company, and is to be divided about equally between its Allegheny and New Brighton, Pa., and Louisville works. The northern iron was bought from three or four furnaces on the basis of about $13.75, delivered Pittsburgh. Some of the sellers have a more favorable rate than the 90-cent valley freight rate, although it is understood a small portion of the iron came from the valley. The southern iron was obtained on the basis of $10.25, Birmingham, for No. 2. Although some sellers of northern iron into the Pittsburgh district seem willing to waive a portion of their more favorable freight differentials, yet valley furnaces still continue to obtain $13.50, valley, on small tonnages of foundry grades. Several Bessemer tonnages have sold the past week at $14.90, Pittsburgh, and one Pittsburgh district consumer has taken 2,000 tons of malleable at $14, delivered. A bedstead manufacturer near Butler, Pa., has closed for 1,500 tons of foundry for last half with a nearby furnace. An inquiry for 10,000 tons of basic for delivery over third quarter is out, but it is rather indefinite. Inquiry for small lots of various grades is better than for several days including inquiries from both Johnstown,

(For complete prices see page 48).

Pa., radiator concerns, 1,500 tons of foundry from a maker of railroad equipment in the immediate Pittsburgh district, while a Pittsburgh steel maker is asking for 500 tons of Bessemer iron for third quarter and a Buffalo subsidiary of a Pittsburgh interest wants 500 tons of foundry iron. Forge iron also is the subject of several small inquiries rather indefinite in their nature.

Melters Buying Sparingly

Melters of foundry and malleable pig iron in Chicago territory are closing for their immediate requirements more freely than in recent weeks, but for the most part are taking smaller tonnages than are normal for their requirements at this season. Inquiry continues active and much of it is for fourth quarter and first half iron. However, makers are extremely shy about quoting figures beyond third quarter and almost universally refuse to make a quotation beyond the end of the year. A considerable tonnage of foundry grades is being booked, but the buying movement is not comparable to that of January and February. One feature of the present inquiry is that melters are asking quotations from makers outside their normal territory, evidently seeking to broaden competition and having a hope that in some other territory they may find some one willing to sell at a lower rate than those in whose natural field they are located. So much tonnage remains undelivered on contracts made for first half that it is having a decided effect in reducing the tonnage needed for second half operations.

Both No. 2 foundry and malleable are quotable at $14, Chicago furnaces, and while some business undoubtedly was booked some weeks ago on the basis of $13.50 to $14, Chicago furnace, the minimum quotation apparently has disappeared. In fact some high silicon iron is now being booked at $14.25 and $14.50, Chicago furnace, but the ordinary differentials for high silicon are not being regarded as strictly as is the case in a normal market.

Southern iron is still shut out of this market and the quotation appears to be pegged at $10.25, Birmingham, equivalent to $14.60, delivered, Chicago, turned down by southern sellers.

Cincinnati Prices Weaker

A small amount of Tennessee iron has been sold at $10, Birmingham basis, for No. 2 foundry, for third quarter shipment, but this price was withdrawn the latter part of last week. A large Birmingham company is however, understood to be quoting $10 for prompt iron. The general quotation is $10.25, Birmingham basis, for No. 2 foundry, for last half delivery and $10.50, Birmingham basis, for last quarter delivery alone. One furnace in the Birmingham district sold an aggregate of 850 tons last week at $10.25, Birmingham basis, for No. 2 foundry, for last half delivery in the Cincinnati district.

A limited amount of southern Ohio resale iron is obtainable at $13 to $13.25, Ironton basis, for No. 2 foundry. Southern Ohio furnaces are firm at $13.50, Ironton basis, for this grade, for either prompt or last half delivery. The Welston furnace, at Welston, O., the Hamilton furnace, at Hanging Rock, O., and the Lawrence furnace, at Culbertson, O., will be blown out the latter part of this week, and the Union furnace at Ironton, O., will be blown out about August 1. This will leave only the Nellie furnace at Ironton, O., in blast in southern Ohio, with the exception of one stack in Columbus, O.

The market during the past week has not been as active as the week previous. A southern Michigan melter has taken 1,000 tons of southern No. 2 foundry for the last half, and 300 tons of silicon four to five per cent has been sold to a manufacturer in the same territory. The Lima Locomotive Corporation has taken 1,000 tons of foundry iron which was divided between two Lake furnaces. The R. F. Avery Mfg. Co., of Louisville, Ky., has closed for 800 tons of southern foundry iron and the Standard Sanitary Co. has taken about 2,000 tons divided between northern and southern grades for its Louisville plant.

Although southern No. 2 pig iron is freely offered at St. Louis at $10 to $10.50, Birmingham, no large tonnages are changing hands. One sale was made near Waterloo, Ia., last week of 3,000 tons of northern iron, and also a number of small lots. Inquiries are in the market for 300 tons of southern No. 2; 1,000 tons of northern; 800 tons of southern No. 2, and 600 tons of high silicon iron.

Inquiry Increases at Buffalo

Furnaces of the Buffalo district report sales of about 10,000 tons for the week, of all grades, and an increase in the volume of inquiries, compared with the activity of the past few weeks. A considerable tonnage is now being negotiated. Measured by the range of a larger period, the improved activity is but slight, as the orders booked are not up to the normal mark. There has been no change in prices in the past week.

The New York Car Wheel Works, Buffalo, which has the order for a large share of the segments for the new tubes under the East and North rivers at New York City, has not placed the contract for the pig iron required, taking about 45,000 tons. Low phosphorus irons and some malleable will be included in the order which it is expected will be placed during the present week.

Prices Not so Soft

A slight tightening of prices which arises from the inclination of makers to avoid profitless sales, is manifested in the New York market. Buffalo makers are holding more firmly to arrange for $13 to $13.50, furnace, for No. 2X. A central Pennsylvania maker has advanced its schedule to $13.25, furnace for No. 2X on all new business, and it has been cleaning up all outstanding quotations on the lower levels. The market possesses little vigor, but there continues a fair volume of buying in a desultory way. A Dover, N. J., stove manufacturer bought 3,000 to 4,000 tons of 2 to 2.50 silicon for last half, paying $14.55, delivered, for a part and a slightly lower price for the remainder. A new inquiry for 1,000 tons of high silicon iron for western shipment, a number of smaller lots and one or two quiet negotiations, involving good-sized tonnages, are before the market. The large General Electric Co. inquiry still is pending. An interesting development of the week is the withdrawal from the eastern market of the Wabana, N. S., iron of the Dominion Iron & Steel Co., due to the fact that the company has made heavy sales of steel products, which will take up any surplus in its production for some months. Whether this iron will be re-offered later, is not certain at this time. Total sales of Wabana iron in this country in recent months were approximately 20,000 to 25,000 tons, and deliveries have been made upon most of these.

Dull at Birmingham

Furnace operators at Birmingham state that a company having the contract for making segments for the East River tunnel has asked for quotations on a 50,000-ton order of pig iron, but up to date no buying has been done. The Birmingham market continues quiet and some spot iron is being sold at $10, Birmingham, for No. 2. The usual quotation for the third quarter is $10.25 while for the last quarter $10.50 is being asked. Southern buyers have been holding out for $10 iron and some of them are getting it, but furnaces, as a rule, are resisting making this price for anything but immediate delivery. One Birmingham maker reports an inquiry of 2,000 tons, of which 1,500 tons are low grade iron, No. 4 foundry, which is said to be scarce in the Birmingham district. All orders for the

(*For complete prices see page* 48).

Closing of Sheet Mills

**May Have Important Effect on the Market—
Brier Hill Signs Scale**

Although Chicago quotations on steel sheets remain unchanged, there is much speculation as to the effect which will follow the expected closing of eastern sheet mills which have wage agreements with the Amalgamated Association. Inability of those interested to come to an agreement at Atlantic City last week leaves the expectation that mills will close Tuesday night in the absence of a wage agreement and with approximately 34 per cent of the independent sheet mills thus out of the market, it is believed prices will show an effect.

At present, quotations in this market are fairly represented by 1.93c to 1.98c for No. 28 gage black and 2.88c to 2.93c for No. 28 gage galvanized. One producer in this territory will close only one day, for inventory, and has sufficient business in sight for normal operation through July.

Sheet mills could fill their books comfortably with future contracts at present prices, but inasmuch as unfilled tonnage without specification means nothing, mills are insisting that specifications accompany orders or they are not booked. Further the plan is gaining ground to make contracts read so that unfilled portions will be cancelled at the end of the period for which they are drawn.

Middletown Plants to Reopen

The two Middletown, O., plants of the American Rolling Mill Co. are closed for mid-summer alterations and repairs and will re-open again in full on July 6. The Zanesville plant of this company has been operating without interruption. Business is holding steady despite the fact that makers in this territory have refused to meet lower quotations of competitors in adjoining districts. Prices here are unchanged at 1.90c to 2c for black sheets No. 28 gage, 2.85c to 2.95c for galvanized No. 28 gage, and 1.55c for blue annealed No. 10 gage, all Cincinnati basis.

Brier Hill Signs Scale

The signing by the Brier Hill Steel Co., Youngstown, Tuesday, of the Amalgamated Association wage scale for the year 1914-15 beginning July 1 on the basis substantially of the 1913-14 agreement gave an important turn to the operating side of the middle western sheet steel industry. It is understood several other mills in the valleys have signified their intention of signing the same scale. However, several of these, including the Brier Hill concern, will close this week for needed repairs which may require several weeks to complete in their entirety. Possibly because of the threatened shutdown through possible disagreement over the scale, specifications have been good the past week at most mills affiliated with the Amalgamated Association, and the American Sheet & Tin Plate Co. is operating its sheet mills at about the same rate as last week, around 60 per cent. Mills refuse to sell over extended periods at today's prices which substantially are unchanged, although blue annealed sheets continue irregular.

Boat Plates

Ordered By New York Company — Bids on Panama Plates

The New York Ship Building Co. has been awarded a merchant vessel for the coastwise trade, which will require about 3,500 tons, largely plates. Small sales for early delivery still represent the main character of the New York market and most of this business is going to eastern Pennsylvania mills, where 1.26c, delivered, or 1.10c, Pittsburgh, is readily obtained. Where the tonnage has been larger, this price has been shaded. Some business also still is being taken at 1.31c, delivered. Not many plate contracts are being made, but buyers are more interested.

Gets Plates for Panama

The United States Steel Products Co. is the low bidder at 1.443c per pound, delivered, for 2,200 tons of cylinder plates for Panama, opened by the government June 25. As reported, the same company also was low on 2,400 tons of similar plates, opened the week preceding. Business with eastern Pennsylvania plate makers continues to make a slightly better showing, but is made up largely by small lots for quick shipment. Contracting is light. Prices are fairly staple at the range of 1.25c to 1.30c, Philadelphia, or 1.10c to 1.15c, Pittsburgh.

No Improvement in Plates

Steel plates have shown no change in the Chicago market recently and business remains small with prices at former levels 1.28c to 1.33c, Chicago, with occasional sales on attractive specifications at 1.25c, Chicago. About 40,000 tons of steel to go into railroad cars recently ordered have been placed in this territory and of this tonnage about 5,000 are specified for immediate delivery with the remainder expected to follow shortly.

Both inquiry and buying of steel plates in the Pittsburgh district are at a minimum and the price has settled to 1.10c, Pittsburgh, without question for general tonnages, and shapes also are held at that figure. No tonnages of size are being figured in the Pittsburgh territory.

(*For complete prices see page* 48).

Ferro Shipments Moving

Consumers of ferro-manganese are taking shipments upon contract, but show no interest in making additional purchases, despite the low prices ruling. An inquiry for 300 tons for last half shipment to a western consumer, is out. The market remains at $38, seaboard. A St. Louis consumer recently closed for 600 tons of 50 per cent ferro-silicon.

Several inquiries from consumers situated just outside the Pittsburgh district have brought out the fact that some resale material may be had in small amounts at a shade under the prevailing quotation of $38 seaboard. It is said offers to sell have been made around $37.50, and even a trifle lower has been reported. But, as pointed out, this is for small quantities of resale material. Most every consumer in the district, however, is covered and not interested in the present market.

Ore Purchase Was For 80,000 Tons

The recent purchase of Lake Superior ore by the Alan Wood Iron & Steel Co. for its Swedeland, Pa., furnaces, it is learned, amounts to 80,000 tons for the year's delivery. The mixture taken includes a hard Marquette and a soft Gogebic ore. No other sales of Superior ore, as far as known, have been made in the east. Foreign ores continue inactive in the eastern market and prices are nominal.

The ore situation on the Great Lakes presents no change whatever. Sales of ore have been few and practically no wild vessels are operating in the trade. No change is expected in the general situation during the present month, and in fact little improvement may occur during the whole summer.

The Garvin Machine Co. has declared a semi-annual dividend of 3½ per cent on preferred stock, payable July 1.

Bar Mills Are Resisting

The Efforts of Agricultural Interests to Contract at Very Low Prices

Agricultural implement manufacturers are showing considerable activity in trying to contract and are still endeavoring to contract on a basis of 1.10c to Pittsburgh for a year's requirements. The mills are, however, showing firmness in resisting granting this price on anything but prompt delivery. On an inquiry for 700 tons for immediate shipment to a Toledo wagon manufacturer the lowest price quoted was 1.10c, Pittsburgh, and that was made by several companies. The manufacturer is now threatening to buy iron instead of steel. The prevailing quotation up to Jan. 1 is 1.15c, and it is very doubtful whether a lower price could be obtained except for immediate delivery. A few contracts have been made at 1.20c, Pittsburgh, for the six months beginning Jan. 1, 1915, but mills are not inviting business of this kind.

Quotations at Pittsburgh

The sale of steel bars for delivery beyond the first of the year has occasioned some interest in the Pittsburgh district, but more especially in the method of distributing the price through the various quarters. This business applies particularly to those tonnages closed with certain agricultural implement makers. Some mills are closing for such tonnages on the basis of 1.15c, Pittsburgh, for delivery through the first half, while others have sold at 1.10c for third quarter, 1.15c for fourth quarter and 1.20c for delivery beyond the opening of the year. In whatever implement business has been done, nothing lower than 1.10c for any delivery has been heard in Pittsburgh.

Union Bar Iron Mills Closed

The end of the Amalgamated Association bar iron wage scale year having arrived, interest shifts naturally away from the market itself to mill operations. It is understood several horseshoe mills in the east and central west have agreed to sign the new wage scale, and at least one Pittsburgh district mill has found its mill "organized", whereas it had been paying the union wage, but its men actually were not members of the Amalgamated Association, and this mill closed July 1. Another conference has been decided upon between representatives of the Western Bar Iron Association and of the Amalgamated Association, following the recent disagreement at Atlantic City, where the manufacturers refused to accept the proposal to increase the 1913-14 base of $5.25 on a 1-cent card by a 75-cent advance. This new conference will be held at Chicago on July 8. In the meantime, all union bar iron mills in the middle west will be closed.

Steel Bars Move Better

Sellers of steel bars in the Chicago market have booked a slightly larger tonnage for immediate delivery at ruling quotations, but no contracts for third quarter were closed during the past week. Agricultural implement dealers are still dickering with steel makers, but so far neither side has receded from the position taken a fortnight ago. Users of steel bars are willing to contract for an indefinite period at 1.33c, Chicago, but mills are unwilling to carry this figure further than Jan. 1, asking 1.38c for the succeeding six months.

Bar Mills Are Closed

No change in the iron bar situation in the Chicago market has taken place in the past week, prices remaining practically at the same level, the leading interest quoting 1.07c and some outsiders selling small tonnages at lower than this level. Some developments in the market are expected in the near future, as mills generally have shut down pending agreement with the Amalgamated Association on the wage scale, the old agreement having expired June 30. With several producers thus out of the market, it is not unlikely prices will be affected.

Specifications Show Increase

Sellers of steel bars in the Philadelphia district generally report better specifications in June than in May. A moderate amount of contracting is being done and the usual price is 1.30c, delivered, or 1.15c, Pittsburgh, for last half, though there are reports that $1 less has been done for third quarter. An attractive specification for prompt delivery would probably bring out 1.10c, Pittsburgh. Considerable negotiations are under way including the large requirement of a Wilkesbarre, Pa., company. The June volume of shafting business increased considerably with some eastern makers, one of them reporting the largest bookings of any June in its history. Prices, however, are weak, 66 to 67 off being general and as low as 68 is reported.

Closing Bar Contracts

Some contracts for steel bars are being made in the New York market, usually by the smaller trade, at 1.31c, delivered, or 1.15c, Pittsburgh, for third quarter. In some cases, it is understood, this price was paid for third quarter and $1 higher for fourth quarter. Some larger requirements by New York state implement makers are expected to be closed shortly. Buyers show much more willingness to place or consider contracts. June specifications for bars with leading sellers in the metropolitan district show some betterment over May.

At Buffalo orders for a fair volume of bars has been placed during the week, although the majority of the orders were for limited tonnages. Some of the mills and agencies are declining to take 1.10c, base, even for favorable deliveries, believing that this price will soon disappear from the market. The prevailing quotations are at 1.15c, base, except where concessions have been made in competition for favorable tonnages and specifications.

In the Buffalo district mills and agencies report a fair amount of business from machinery makers, wagon and auto manufacturers for small shapes, booked in small tonnages for immediate consumption. Contracts are being confined to third quarter delivery at 1.15c, base. The mills are not disposed to take on low-priced tonnages beyond that time at the prevailing schedule, and what few customers want to cover for their requirements into the fourth quarter are being asked an advance of $1 per ton over the third quarter figures.

Shafting Improves

Some improvement is noted in the cold-rolled shafting market in the Pittsburgh district, makers reporting heavier specifications received in June than in any similar period since January, while actual orders have surpassed May bookings from 40 to 50 per cent. Of course, May now is regarded as a disappointment in the iron and steel trade. Prices are not so irregular, leading shops asking 66 off on future deliveries, although desirable tonnages for prompt delivery are going at 67 off.

The Columbia Motor Car Co.'s plant at Hartford, Conn., it is reported, has been sold to the Sears-Roebuck Co., Chicago. It is rumored the plant may be used for the manufacture of typewriters.

(*For complete prices see page* 48).

Panama Scrap Offered

And Greater Tonnage is Expected to Come Within a Short Time

A quantity of Panama canal scrap continues to be offered in the New York market. If a satisfactory price is obtained on a lot of several thousand tons of wrought scrap in the form of bars, which has been recovered from the demolishing of some of the construction work at the Isthmus more tonnage is expected to be brought in at this time. About 1,500 tons of this material now are in storage in Brooklyn, having been there for several months. The metropolitan scrap market remains dull and weak. Sales still are being made with difficulty, as buyers are naming their own prices, which generally are very low, and are sticking to them.

Buying Still Lags

A little more interest is being shown by buyers of old material in the eastern Pennsylvania market, but sales show no material increase, and conditions are slow. Several of the steel works are holding up shipments on recent orders. This appears not to be due to reduced consumption, but to the vigorous way in which dealers and brokers have been shipping in material within a brief space of time, which the works have not been able to handle. In the absence of much selling, prices manifest small change.

Soft at Pittsburgh

Some softening of prices is noted the past week in the Pittsburgh iron and steel scrap market, but more especially in heavy melting steel and cast. Transactions have been few enough, and if prices actually were tested it is possible lower quotations than those quoted today might be obtained on these two commodities. Busheling and other rolling mill scrap are in little demand since bar iron mills have prepared for the usual summer shut-down. Borings and turnings also are slow.

Discouraging at Cleveland

The situation in the iron and steel scrap market in the Cleveland district is more discouraging than it has been in several weeks. Demand is at a minimum. Prices have changed little, but a drop of 50 cents a ton would not be surprising in some grades within the next week. Embargoes on shipments of scrap to some plants, including the American Rolling Mill Co. at Middletown, and La Belle Iron Works at Steubenville, and refusals of shipments until after the middle of July by several other consumers, have resulted in flooding remaining outlets and consequent weakening of the market. Heavy melting steel now may be quoted on a basis of $10.25 to $10.60 gross ton, dealers' buying and selling prices for yard scrap. Machine shop turnings have declined 25 cents to $5.25 to $5.50.

Buffalo Markets Better

The old material dealers of the Buffalo district report an improvement in the activity in heavy melting steel, but only sufficiently so to distinguish it from the other lines. Several sales, representing a fair tonnage, have been made during the week in turnings and borings. The inquiry and the sales in the other lines is reported to be light by all of the dealers. The price schedule has undergone no changes in the past week.

Demand Lighter at Cincinnati

With the closing of several large rolling mills in Cincinnati territory for mid-summer alterations and repairs, the scrap market has lapsed into further dullness and is now practically at a standstill. Shipments have been withheld in numerous cases and the embargo declared against delivery of iron and steel scrap to the American Rolling Mill Co., Middletown, O., is still maintained. Foundries in this territory are very idle and some are running only a few melts each week, with the result that they are taking very light requirements. Stove plate shows a slight decrease from last week, being now quoted at from $6.50 to $7 per net ton. Other prices are unchanged.

Scrap Market Stationary

Scrap in the Chicago district is absolutely featureless and with one of the largest consumers closed down for mid-summer repairs, the demand is further curtailed. Contracts are few and far between and prices are largely nominal with little change from week to week. Dealers believe prices at the present level warrant them in storing scrap for future selling and those who have sufficient capital are long on the market, with excessive accumulations, waiting the turn of the tide. About 15,000 tons of railroad scrap are being offered. The Great Northern has 1,400 tons, practically all steel rails and similar products, the Chicago & North-Western, 4,500 tons and the Baltimore & Ohio, 9,600 tons.

Low Cotton Tie Price

Unusual Interest on Account of Fear of Foreign Competition

The Carnegie Steel Co. has announced at Pittsburgh the opening of the 1914 steel cotton tie market at 65c per bundle of 45 pounds, July basis. More than ordinary interest has been manifested in the cotton tie price for this year because of the reported effort of British and Belgium cotton tie makers to enter the American southern market, some of the English-made ties having been held for several years in New Orleans warehouses. If these ties have been waiting for a higher price to make their appearance, it will not be this year. The new price just announced is the lowest for over a dozen years, perhaps longer. Last year, the opening price was 80c a bundle and some question arose as to whether the usual makers would take hold of the tonnage at that figure, but they did finally. In 1912 the price was 70c, and only once previous to that year was the price as low as that, this case being in 1909. Cotton ties have sold as high as 95c, this being in 1907. Mills manufacturing cotton ties are: Carnegie Steel Co.; Sharon Steel Hoop Co., Sharon, Pa.; Alton Steel Co., Alton, Ill.; Atlanta Steel Co., Atlanta, Ga., and Connors-Weyman Steel Co., Birmingham, Ala. Government and independent estimates of the condition and acreage of this year's cotton crop place it at about last year's figure at this time of year. That means between 70,000 and 75,000 tons of ties will be required this year, of which about two-thirds will be manufactured in the Pittsburgh district.

The general hoop and band market at Pittsburgh continues unchanged in conditions and prices.

The Riter-Conley Mfg. Co., Pittsburgh, has taken contract for 20 oil tanks of 55,000 barrels each, to be erected for operators in the Cushing oil fields. Each tank weighs about 150 tons, being 30 feet 4 inches high and 114 feet 7 inches in diameter. The company is turning one of these tanks a day, fabricated completely.

(*For complete prices see page* 48).

Foundry Coke is Selling

But There Are Some Signs of Softness in the Pittsburgh Market

The feature of the Pittsburgh coke market has been the buying by foundries into next year. The bulk of the recent buying has been done around $2.50, ovens, although some consumers have been able to get $2.40 coke. For prompt delivery, foundry coke has sold down even to $2.25, ovens, but not in large quantities. For the larger portion of the foundry coke placed the past week, it is believed the prevailing market quotations governed. However, there is no mistaking that the foundry coke market shows some signs of softness.

The spurt in sales of standard furnace coke noted one week ago in Pittsburgh seems to have run itself out. Several negotiations which appeared about to close have been put off for one reason and another, some furnacemen still being in a quandary, apparently, as to whether they should continue their furnaces in operation or blow out. It would seem that, while settling this question in their own minds, they will continue to buy just as their needs arise. Prompt furnace is going at $1.75 to $1.85, ovens, and contract still is quoted at $1.85 to $2, ovens, probably as much tonnage moving at one extreme as the other.

Large Sale of Pocahontas Coke

Cincinnati, June 30.—Southern Ohio furnaces have taken about 45,000 tons of Pocahontas coke for last half shipment. This is one of the largest sales of furnace coke that has been made in this territory for some time, as furnaces have been buying from month to month because of concessions being granted on prompt shipment fuel.

Buying of foundry coke in fair lots continues in the Cincinnati district, but the aggregate tonnage is far below the normal. The first of July is at hand, at which time a large number of foundry contracts expire, and it is estimated by dealers that at least 60 per cent of melters in this territory have closed for next year's requirements. Very few, however, have ordered as much as in previous years, either because of lack of business, or because they have a good tonnage left over from last year's purchases. Furnace coke is selling in small lots, as operators are buying from month to month because of the advantage of spot shipment prices. Quotations on furnace and foundry coke in all districts are unchanged from those of

The coke market is very dull in the St. Louis territory, with prices standing at $2.50 to $2.75 for Connellsville and Virginia 72-hour foundry grades and $2 to $2.25 for 48-hour furnace grades.

In the Cleveland district, foundries are still contracting through the last half at $2.50, ovens, and in some cases contracts are made for a year at this price, but a leading coke company is quoting $2.65 for the first half of next year.

A Lehigh valley furnace has purchased 12,000 tons of Connellsville furnace coke for last half at $1.85, ovens. A Schuylkill valley consumer also has closed for several thousand tons monthly for last half. A New York state furnace company took its July requirements at $1.85, Connellsville ovens.

Wire Prices Shaded

New business for wire products in the Pittsburgh district continues light and generally specifications have not shown improvement. While consumers express desire to cover future needs at prevailing minimum prices, mills are not willing to sell on contract under $1.55 per keg, Pittsburgh. For prompt shipment nails are selling at $1.50; plain fence wire is going at $1.30; but plain wire for manufacturing purposes is held at $1.35. Prospects for a quiet summer continue to appear, and when some mills shut down today it may be for a longer period than now appears, unless something tangible turns up in the meantime.

Bolt manufacturers are contracting for bolt material and specifications on wire and wire nails are coming in fairly well in the Cleveland district, but irregularity in prices continues.

Pipe Business

Shows Improvement—Low Prices on Boiler Tubes

Steel line pipe business has picked up so well following the recent good buying by western oil concerns, that mill activities in the Pittsburgh territory bid fair to be increased gradually. It is understood the National Tube Co. will add somewhat to its McKeesport, Pa., works running schedule after July 4, but just to what extent appears problematic as yet. A Pittsburgh engineering concern is tentatively in the market for a tonnage of line pipe that may amount to some hundreds of thousands of dollars worth.

Low prices are still being made on desirable business in boiler tubes. The very low price of 74-5 and 5 off on steel tubes, reported several weeks ago, has not disappeared, but contracts have been made at 72 and 73 off.

Price Shading

Attempted on Billets, But Without Much Success

Billet and sheet bar consumers in the Pittsburgh district, being fairly well covered, have not been figuring in the market only for small tonnages to fill in. Some buyers are endeavoring to shade present quotations but without marked success so far. The wire rod and muck bar markets show no change, although the shutting down of certain puddling mills due to wage scale matters may cut the supply of muck bar. However, this is not regarded as important at this season. Some of the larger billet and sheet bar makers report better aggregate business in June than either in May or April, but this cheerful condition is not general.

Quiet at Ashland

The situation is very quiet at Ashland. The Ashland Steel Co. is still operating, but mostly on orders accumulated during its recent shutdown of about a month. The output is in excess of demand. The month of June just closed has been very unsatisfactory, and manufacturers do not expect July to be much better.

Cast Iron Pipe Prices Low

While the volume of new business in the eastern cast iron pipe market is holding up to fair proportions, prices still fail to respond. Attractive lettings usually bring out very close figures. The large inquiry for the government for Panama shipment, which is to close July 6, aggregates slightly over 12,000 tons, including approximately 7,000 tons of 36-inch, 5,000 tons of 30-inch, and 300 tons of 24-inch.

Were it not for routine orders, the cast iron pipe market would be in the dumps. Comparatively little competitive business is in sight. A new angle has presented itself in the Highland Park, Mich., project and it seems likely that instead of laying a portion of the line with 36-inch cast iron pipe and the remainder concrete and wood, 30-inch cast iron pipe for the entire distance may be substituted. Pocatello, Idaho, has taken bids for 1,000 tons of water pipe.

(*For complete prices see page* 48).

Better Outlook

For Sturctural Business in the East—Low Fabricating Prices

A better outlook for the structural market is shown in eastern districts, where the railroads seem likely to be more liberal buyers in the near future. Considerable work upon which bids are in remains suspended in metropolitan territory, as buyers are deliberate in acting and awards are rather slow. Smaller inquiries are more numerous. Prices are unchanged at 1.26c to 1.31c, delivered, or 1.10c to 1.15c, Pittsburgh.

Some extremely low prices are being made by fabricating and erecting contractors in the same district, but it is confidently asserted by mill representatives that less than 1.10c, Pittsburgh, cannot be done on plain material. The contract for 1,500 tons for the shops of the Cleveland Railway Co. has been awarded to the Riverside Bridge Co., Martins Ferry, O. The McClintic-Marshall Co. has taken the contract for the Federal Foundry Co. plant at Indianapolis, which calls for 650 tons of steel.

Contract for Mill Buildings

Two mill buildings for the Western Reserve Steel Co., to be erected at Warren, O., have been taken by the Riter-Conley Mfg. Co., Pittsburgh, requiring 750 tons of steel. One building will be 80 x 264 feet, and the other 175 x 624 feet. This is the largest structural contract closed in the Pittsburgh district the past week.

The Riter-Conley company also will furnish the structural steel which Cuthbert Bros. Co. will erect for the Fidelity Title & Trust Co. on Federal street, Pittsburgh. This building will be seven stories, 26 feet 9 inches wide and 107 feet 9½ inches long. The contract for fabricating and erecting the 1,400 tons of steel for the addition to the printing office of the *Pittsburgh Gazette-Times* finally has gone to the Fort Pitt Bridge Works. The original taker, which was the American Bridge Co., asked to be relieved of its contract. The contract calls for the work to begin on Aug. 21 and to be completed Dec. 25, when the printing office will be moved into it, as Christmas day is the only day in the year when the newspaper does not publish. It is understood the desired deliveries caused the American company to ask to be relieved of the contract. Heavy penalties are understood to be involved in the construction.

Far West Takes Business

No change is apparent in the situation as to structural shapes in the Chicago market, the ruling price being 1.28c to 1.33c, Chicago, with occasional unusually attractive orders commanding 1.25c, Chicago. The latter, however, are comparatively scarce.

Structural lettings the past week are slightly more numerous than usual and the far west continues to take the larger number, although the tonnage in each individual instance is not large.

The principal Buffalo interest has taken an order for 1,500 tons of steel sheet piling for use on the Erie barge canal work in New York state.

New Business Moderate

New structural business in the Philadelphia and southwestern districts continues moderate, though a power house at Philadelphia, involving 5,000 tons, now is offered. Specifications to eastern Pennsylvania mills, however, are keeping up in fair volume, much of these being due to miscellaneous small jobs which seem to be coming up quite freely. The eastern price situation is unchanged, 1.25c to 1.30c, Philadelphia, or 1.10c to 1.15c, Pittsburgh, representing the market.

CONTRACTS AWARDED.

Western Reserve Steel Co., Warren, O., to Riter-Conley Mfg. Co., for two mill buildings, 750 tons.

Fidelity Title & Trust Co., Pittsburgh, 7-story building, to Riter-Conley Mfg. Co.

Lackawanna Bridge Co., Buffalo, contract for 500 tons steel, power house at Cohoes, N. Y.

Rochester Bridge Co., Rochester, contract for two bridges, Hamilton county, O., taking about 480 tons structural steel.

Shops for the Cleveland Railway Co., 1,500 tons, awarded to Riverside Bridge Co.

New plant of Federal Foundry Co., Indianapolis, 650 tons, to McClintic-Marshall Co.

Addition to plant of Pennsylvania Sugar Refining Co., Philadelphia, 850 tons, awarded to American Bridge Co.

Bridge over Connemaugh river, near Sheridan, Pa., for Pennsylvania railroad, 900 tons, award made, but successful fabricator not yet announced.

Underhill loft building, West Thirty-eighth street, New York City, 1,800 tons, awarded Levering & Gerrigues.

Pier shed and bulk head at pier 26, East river, New York City, 250 tons, awarded the Lackawanna Bridge Co.

Garage, West Twenty-ninth street, 250 tons, awarded American Bridge Co.

Addition to Fidelity building, Baltimore, 250 tons, awarded Dietrich Bros.

Great Northern Railway Co., mail and express building, Minneapolis, Minn., 1,150 tons, to the Milwaukee Bridge Co.

J. Sockolov, San Francisco, Cal., 15 story hotel building, San Francisco, Cal., 750 tons, to the Central Iron Works.

Harris-Emery department store, Des Moines, Ia., 727 tons, to the Morava Construction Co., Chicago.

Thompson Falls Power Co., power house, Thompson Falls, Mont., 669 tons.

Bridge over the Colorado river at Yuma, Arizona, 470 tons, to Omaha Structural Steel Co.

Clatsop County, Oregon, highway bridges at Astoria, Ore., 101 tons, to the Northwest Steel Co.

San Luis, Obispo County, Cal., bridge over Salinas river at Paso Robles, Cal., 274 tons, to American Bridge Co.

San Diego Electric Co., viaduct, San Diego, Cal., 350 tons to Milliken Bros.

CONTRACTS PENDING.

Ralston-Purina Co., of St. Louis, feed mill and elevator at Buffalo, bids to be called for latter part of week, taking large tonnage reinforcing bars and some structural steel.

City of Buffalo, Department Public Works, Abbott Road bascule bridge, over Buffalo river, 1,200 tons steel, bids to be advertised in two weeks.

Subway terminal building, Newark, N. J., 7,000 tons, bids to be taken July 9.

Section No. 1 of Eastern Parkway subway, Brooklyn, 6,430 tons, general contract awarded Cranford Co.

School buildings, South Manchester, Conn., 500 tons, bids taken.

Bridge for Pennsylvania railroad near Pittsburgh, 900 tons, bids taken.

Apartment at Eighty-fourth street and Broadway, New York City, for Paterno Bros., 700 to 1,400 tons, depending upon design finally adopted. Bids being taken.

Municipal building, Waterbury, Conn., 800 tons, Geo. A. Fuller Co. awarded general contract.

Power house for Philadelphia Electric Co., Philadelphia, 5,000 tons, bids taken.

Addition to Hotel Traymore, Atlantic City, 1,000 tons or more, bids asked.

(*For complete prices see page* 48).

Brisk Business

Enjoyed by Chicago Warehouses, But Not Elsewhere

Warehouse Business is Brisk

Business of iron and steel warehouses in Chicago is improving week by week and June promises to show a large percentage of increase over May, although the volume of business still is far behind that done in June last year. Structural materials are moving in larger volume, but one effect of the brick makers' strike was to put over to next year considerable construction. Prices remain unchanged at last week's figures.

Warehouse Business Steady

Books of various warehouses in Cincinnati show that business done in June exceeded that of either April or May. The general report is that orders were good during the first part of June, but gradually fell away during the last two weeks. Today warehouse business is holding steady and is fairly satisfactory. Demand is mostly for building materials, about equally divided for delivery outside and inside of this city.

Less Active at New York

Warehouse business at New York is less active than earlier in the month, when a considerable increase in trade, which with some companies reached fully one-third over May, was engaged. June business, as a whole, however, is considerably ahead of May. Warehouse prices are unchanged.

Largest Car Orders

Placed This Year—More Railway Business in Prospect

New York, July 1. (By wire.)—The Southern Pacific is preparing specifications for cars and is expected to ask bids in a few days for about 4,500. Rumors are current but not confirmed that the Union Pacific also may come into the market shortly for an additional large block of cars. The Chicago & Great Western asks for 500 box cars.

Bids are asked by the Illinois Central for the bridge at Paducah connecting Kentucky and Illinois, requiring about 20,000 tons. This bridge has been under consideration for some years. Bids are asked on the new municipal piers at Philadelphia requiring 3,000 to 4,000 tons. The Pennsylvania Steel Co. gets 900 tons for the Pennsylvania bridge over the Conemaugh river.

Rail and car orders placed by the railroads in June show the largest volume in a number of months. Reported rail sales in that period totaled about 210,000 tons, including 30,000 tons for export, compared with 110,000 in May, 60,000 in April, 61,500 in March, 215,000 in February and 175,000 in January. The June total was due largely to the placing within the week past of the Pennsylvania railroad's order, which, as announced officially, amounts to 137,032 tons. Of this order, 27,032 tons already had gone to the mills on advance and trial lots. The company, to carry out experiments with a section heavier than 100 pounds per yard, ordered this year 15,000 tons of 120-pound rails. The remainder of the order will be of 100-pound sections, substantially on the present specifications.

June car orders awarded builders totaled approximately 16,500, or the largest number of any month of the year. The best preceding month was in January, when about 13,000 cars were ordered. Car orders to date, both to private builders and railroad shops, aggregate about 63,000.

The New York Central lines have increased their recent car order to 8,400 cars. The additional order includes 2,000 box cars for the Merchants' Despatch & Transportation Co. The New York Central lines also still are figuring on 1,000 box and 1,000 gondola cars.

Steel Cars Ordered

One of the largest orders for any product to be placed with manufacturing plants in Cincinnati in recent years has been secured by the Cincinnati Car Co., for 250 steel cars to be built for the Chicago Electric Railroads, Chicago. Last December an agreement was entered into by these two companies for the immediate manufacture and delivery of 128 steel cars with the option of placing 122 additional. The recent order of these 122 cars completes the contract for 250 cars, and calls for an expenditure in all of about $2,000,000. The cars will be constructed completely of steel and will seat 44 passengers each.

Inquiry for Spikes

Some negotiations for railroad spikes are under way, including an indefinite inquiry for the Baltimore & Ohio railroad for last half which may amount to 10,000 to 15,000 kegs; 6,000 kegs for last half for the Seaboard Air Line; 2,000 kegs for third quarter for the Chesapeake & Ohio and same quantity for the Atlantic Coast Line. Spike prices are easy and 1.40c, Pittsburgh, is being made. The Norfolk & Western railroad is inquiring for its last half bolt requirements.

CAR AND LOCOMOTIVE ORDERS.

The Wabash railroad has placed 60 locomotives with the American Locomotive Co.

The Canadian Pacific railroad has ordered 10 locomotives from the Montreal Locomotive Works.

The Chicago & North-Western railroad has placed 10 locomotives with the American Locomotive Works.

The Rutland railroad has ordered one locomotive from the American Locomotive Works.

The Chilean railways have revived an inquiry for 60 locomotives.

The Western Maryland Railroad is about to take action on a purchase of 20 to 30 locomotives.

The Norfolk & Western railroad has taken bids on 10 locomotives.

METAL MARKETS

New York

June 30.

Copper.—The refined copper market continues to be such as to offer little encouragement to producers. There is some buying, but the volume is far below normal proportions, and purchases, as a rule, involve only spot and nearby requirements. As a result, prices have a sagging tendency. Today, electrolytic generally is offered by first hands at 13.50c, delivered 30 days. On a wholesale contract basis, electrolytic may be quoted at 13.35c to 13.40c, cash, New York. Prime casting may be obtained at 13.32½c to 13.37½c, delivered 30 days, and on a cash basis, may be quoted at 13.25c. Good brands of prime lake may be obtained freely at 13.62½c to 13.75c, cash, and these prices probably could be shaded; there is little business to test the lake market. The average prices at which business was done during June on a wholesale contract basis, are as follows: Electrolytic, 13.6667c, cash; casting, 13.5747c, cash; prime lake, 14.0511c, cash.

Tin.—Spot and July tin today are held at about 30.45c, while each succeeding month is held 10 points higher. Considerable business is reported to have been booked at these prices, mainly for spot and nearby delivery. Domestic deliveries during June, amounted to 3,650 tons, which about conforms to expectations. So far this year, domestic deliveries run only about 600 tons less than those during the corresponding portion of last year, which is very satisfactory, considering prevailing business conditions. The tendency of prices in London has been upward during the past few days. This morning, however, the high point, £139 on spot, was reached, and this afternoon the market reacted, spot closing at £137 17s 6d and three months at £139 10s.

Lead.—This metal is very dull. A slight weakness is reported from the west, where one producer is offering lead at 3.77½c St. Louis; other producers, however, continue to ask 3.80c, St. Louis. The New York price continues to be 3.90c, which can be done through August. Foreign demand continues good.

Spelter.—This market displays a tendency toward weakness and shrewd buyers now are able to buy spot and nearby delivery as low as 4.95c, New York. Consumers, however, show little disposition to take advantage of low offers. Prime western brands may be quoted at 4.95c to 5c, New York, which is on the basis of 4.80c to 4.85c, St. Louis.

Antimony.—Prices on antimony continue to show a tendency toward weakness and Hallett's and United States are held somewhat lower. There is very little demand. Quotations on large lots, duty paid New York, are as follows: Cookson's 7.12½c to 7.25c; Hallett's, 6.75c to 6.90c; United States, 6.75c to 6.90c; other brands, 5.65c to 5.75c.

Chicago

June 30.

No improvement is apparent in this market for new metals and prices are little changed from those prevailing last week. Casting copper ranges a shade lower and pig tin also is weaker.

We quote dealers' selling prices f. o. b., Chicago, as follows:

Lake copper, carload lots, 13.75c; casting, 13.75c; smaller lots, ¼c to ⅜c higher. Spelter, car lots, 5.00c; lead, desilverized, 3.80c; sheet zinc, $7.00, f. o. b. La Salle, in car lots of 600-pound casks; pig tin, 30.50c; Cookson's antimony, 7.25c; other grades, 5.75c.

Continued weakness characterizes the old metals market and copper, brass and tin products have yielded several points. Zinc, lead and aluminum are holding somewhat firmer. Practically no business is current and dealers are buying only such material as is offered by regular customers.

We quote dealers' selling prices f. o. b., Chicago, as follows:

Copper wire, crucible shapes, 12.50c; copper bottoms, 11.00c; heavy red brass, 11.00c; heavy yellow brass, 8.75c; No. 1 red brass borings, 10.00c; No. 1 yellow brass borings, 7.50c; brass clippings, 8.50c; lead pipe, 3.60c; zinc scrap, 3.90c; tea lead, 3.30c; No. 1 aluminum, 11.50c; No. 1 pewter, 19.00c; block tin pipe, 28.00c; tin foil, 33.00c; linotype dross, 2.75c; electrotype dross, 2.75c; stereotype plates, 4.00c; stereotype dross, 2.75c.

Larger Bookings

By Steel Corporation—Better Showing is Expected

New York, July 1. (By wire.)—The United States Steel Corporation bookings are now running ahead of shipments, and indications are that June unfilled tonnage will about break even and may show a small increase. Despite some reports to the contrary, new business has been heavier the last half of June than for the first half. Some slight increase in operations is being made. One furnace at Cleveland is blowing in. Operations of the leading interest are now about 65 per cent. Heavy buying of bars has been done by the implement trade, which distributed among various makers. Usual prices have been 1.15c, Pittsburgh, for last half of 1914, and 1.20c for first half of 1915.

Southern City

Will Entertain the American Iron and Steel Institute

Birmingham, Ala., will entertain the fall meeting of the American Iron and Steel Institute, according to the decision of the directors of the institute at their monthly meeting in New York City, June 26. The dates officially selected are Thursday and Friday, Oct. 29 and 30. The formal program will be presented on Thursday. Friday and possibly the day following will be devoted to the visitation of the works and points of interest in the Birmingham district. The directors admitted to membership 82 additional names, including 22 to the active and 60 to the associate lists.

Large Order for Persia

New York, July 1. (By wire.)—The National Tube Co. has received a large order for line pipe for the Anglo-Persian Oil Co., of Persia. The contract involves 15,700 tons of 10-inch.

Signed the Scale

Pittsburgh, July 1. (By wire.)—Three independent steel sheet concerns have signed the wage scale of the Amalgamated Association. These are the Brier Hill Steel Co., Youngstown, with Empire and Thomas mills at Niles, O.; the Whitaker-Glessner Co., with sheet mills at Wheeling; the Trumbull Steel Co., at Warren, O. A meeting is being held here this afternoon by a number of independent sheet mill owners.

Slag Charge

Arouses Much Interest—Will Submit to Washington

Pittsburgh, June 30.—The question of carriers in eastern Ohio, western Pennsylvania and West Virginia, charging 20 cents a ton for hauling away slag and 35 cents a ton for wasting refuse material from iron and steel industries located in that territory is to be carried to Commissioner Meyer, of the Interstate Commerce Commission.

A committee of representative furnace and steel works executives and traffic managers will be named soon by President James A. Campbell, of the Youngstown Sheet & Tube Co., chairman of the industrial representatives who met with leading carriers' representatives last Friday in the Fort Pitt hotel, Pittsburgh. This committee will wait upon Commissioner Meyer, of the Interstate Commerce Commission, at Washington within ten days, if possible, and ask his interpretation of his former ruling. This ruling was laid down in the Pittsburgh Steel Co.'s iron ore rate case, the commissioner suggesting strongly that the railroads should charge for this slag wasting service.

Bids on Vessels

New York, July 1. (By wire.)—The Merchants' and Miners Transportation Co. is taking bids on three large coastwise vessels and the Luckenbach interest for two vessels. The boat just taken by the New York Shipbuilding Co. is for the coastwise lumber trade.

Decisions in Ore Rates

Washington, July 1. (By wire.)—In a decision handed down this morning in the case of the Ontario Iron Ore Co., the Interstate Commerce Commission holds that the present rate of $1.10 per gross ton of ore from Fruitland and Ontario, N. Y., to Emporium, Pa., and the present rate of $1.60 to Earlston, Saxton and Riddlesburg, Pa., is not unreasonable. The present rate of $1.60 to Curtin, Milesburg and Bellefonte, Pa., is found to be unreasonable to the extent that it exceeds $1.40. The latter rate is ordered to be put into effect on Aug. 15.

Gary Hopeful

But Says Tariff Policy Must Be Changed

New York, July 1. (By wire.)—Judge Gary, before sailing for Europe today, issued a statement of his opinion on conditions, expressing his belief in improvement in the fall.

"We are," he said, "already witnessing an increase in tonnage and it will be further increased, I trust."

Judge Gary says business conditions generally in the country are bad and during recent months have been worse than any time in the last decade. He says the tariff has adversely affected business. He predicts that it is only a question of time until the public will demand a change in tariff policy. He adds he is not certain whether manufacturers will be compelled to reduce wages and asserts no reductions will be made unless they become absolutely imperative.

Large Tonnages

Let For Subways and Elevated—More To Be Awarded

New York, July 1. (By wire.)—Complete official figures show that steel awards for subway and elevated extensions in this city to date aggregate over 400,000 tons, of which the American has taken about 300,000 and independents about 110,000 tons. It is estimated that about 200,000 are yet to be placed.

Blast Furnace Notes

Newberry furnace of the Lake Superior Iron & Chemical Co. was blown out June 30. Repairs are to be started at once, and the company will endeavor to keep its entire force at work until the furnace is resumed. This company's plant at Manistique, Mich., has been shut down for 10 days and probably will be out of blast through the summer. Considerable improvement work is under way, which is employing most of the men formerly at work on the blast furnace.

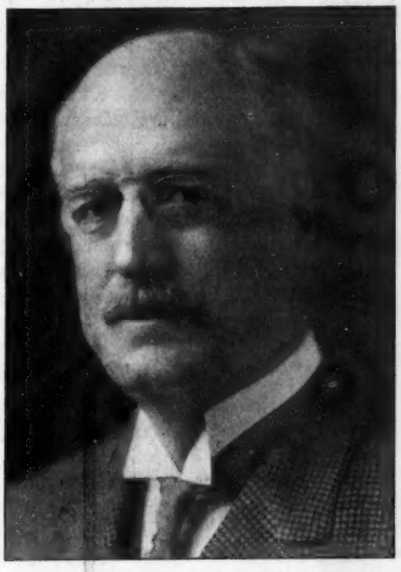
Furnace A at the Northwestern Iron Co.'s plant at Mayville, Wis., which is being relined, is expected to be ready for service about July 20, and will be blown in about that time.

On July 4, the Cherry Valley furnace of M. A. Hanna & Co., at Leetonia, O., and Hanging Rock furnace of the Hanging Rock Iron Co., at Hanging Rock, O., will be blown out.

MEN OF THE IRON TRADE

Who they are Where they are What they are doing

John O. Henshaw, a vice president and director of Hickman, Williams & Co., Inc., on Aug. 1 will take over the Boston office of that concern. Prior to that date he expects to resign his official position with Hickman, Williams & Co. Mr. Henshaw for a number of years was a member of the pig iron firm of N. S. Bartlett & Co., Boston. On the dissolution of that company, Feb. 1, 1909, he became a member of the firm of Hickman, Williams & Co., which took over the offices of the Bartlett company on that date. Following the incorporation of Hick-



JOHN O. HENSHAW
On Aug. 1 He Takes Over Boston Office of Pig Iron Firm

man, Williams & Co., a little more than a year ago, Mr. Henshaw became a vice president and director to which offices he was re-elected at the last annual meeting. He is also a member of the board of directors of the Delaware River Steel Co., Chester, Pa.

C. M. Means, electrical engineer, Pittsburgh, Pa., has been appointed consulting electrical engineer with the United States Bureau of Mines.

W. L. Jack, who recently resigned as treasurer of the Riter-Conley Mfg. Co., Pittsburgh, has been elected vice president of the Third National Bank, that city.

Albrecht F. Leue, who has been purchasing agent of the Triumph Electric Co., of Oakley, Cincinnati, for the past eight years, has resigned to enter the practice of law. He has opened an office at 711 Mercantile Library building, Cincinnati. Mr. Leue entered the employ of the Triumph Electric Co. in 1900 and held various positions of high rank in that company before being made purchasing agent, in 1906.

William C. Perkins has been elected president of the Rhode Island Perkins Horseshoe Co., to succeed Francis W. Carpenter. Mr. Carpenter is succeeded as director by Dr. F. H. Peckham.

Dudley A. Johnson succeeds the late Sam Mayer as Chicago branch manager of the Joseph Dixon Crucible Co. Mr. Johnson for a number of years has been an assistant to Mr. Mayer at Chicago.

H. W. Green has been elected second vice president of the Lawrence Steel Castings Co., Pittsburgh. Mr. Green has been district sales agent of the American Steel Foundries in Pittsburgh for the past 10 years.

James L. O'Neil, credit manager of the Carnegie Steel Co., Pittsburgh, talked on "Observance of Sales Terms in Relation to the Unearned Discount Evil", at the annual convention of the National Association of Credit Men, June 24, at Rochester, N. Y.

Rufus M. Pile, assistant general passenger agent of the Pennsylvania railroad, who has served that system for more than 44 years, will retire from active service July 1, under the pension rules of the company. He celebrated his 70th birthday on June 25.

W. V. S. Thorne, vice president in charge of purchases of the Harriman lines at New York City, has resigned, effective July 1, and has been succeeded by W. A. Harriman, son of the late E. H. Harriman. Mr. Thorne proposes to retire shortly from active business.

Robert W. Reade, formerly sales agent of the Pennsylvania Steel Co., in the Philadelphia district, has been made assistant general sales manager of the New York office of that company. The title of R. W. Gillespie, in charge of the New York office, has been changed from sales agent to district sales manager.

Thomas H. Mirkil Jr., formerly general manager of the Southwark Foundry & Machine Co., Philadelphia, and for the past four years vice president and general manager of the Poole Engineering & Machine Co., Baltimore, now represents the Treadwell Engineering Co., Easton, Pa., in Philadelphia and vicinity, with offices in the Mutual Life building, Tenth and Chestnut streets.

W. S. Ranson, of Mathew Addy & Co., pig iron brokers, of Cincinnati, has returned from a two weeks' trip to New York, where he extended a business trip into one of pleasure at different New York summer resorts.

E. H. Bell, a newly elected member of the American Iron and Steel Insti-

E. H. BELL,
New Member American Iron and Steel Institute

tute, is vice president of the Railroad Supply Co., Chicago. He was born in Philadelphia and has long been engaged in the railroad service. For the past 18 years he has been connected with the Railroad Supply Co., Bedford building, Chicago, whose principal products are connected with the manufacture of steel track specialties.

Curt A. Ziesing, for some time connected with the Lindenberg Steel Co., 90 West street, New York, the American Branch of the Stahlwerk Richard Lindenberg, A. G., of Reinscheid, Germany, has resigned his New York connection to become connected once more with the home office of his company. He is succeeded in the Lindenberg Steel Co. by Ernest Fischer.

Little Time for the Board Walk

Testing Society Meets at Atlantic City and Pushes Work With Unabated Vigor

ATLANTIC CITY, N. J., June 30. (By wire.)—With a large and representative attendance, the seventeenth annual meeting of the American Society for Testing Materials was opened here today at the Hotel Traymore, three sessions having been held. The program is unusually heavy, as it provides for the consideration of 64 papers and committee reports. A total of 19 proposed standard specifications will be considered and various committees have recommended 21 specifications for revision. Of interest to the iron and steel industry, the new specifications include the following: Standard structural steel for cars; carbon steel bars for springs; methods of chemical analysis for plain carbon steel; recommended practice for the annealing of carbon-steel castings; recommended practice for the heat-treatment of case-hardened carbon-steel objects; cold-drawn steel, Bessemer automatic screw stock and standard methods for Brinell hardness tests of metals.

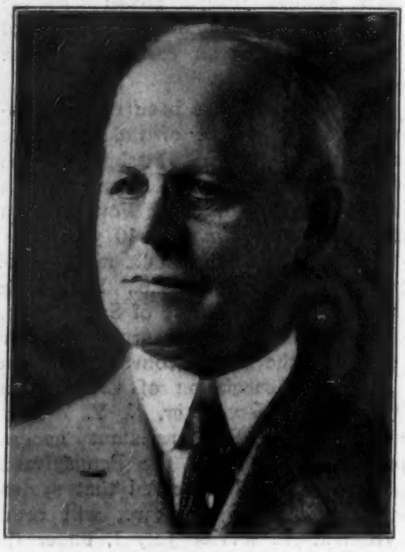
Revisions in the following standard specifications have been suggested and will be considered during the week: Carbon-steel rails, low-carbon steel splice bars, medium-carbon steel splice bars, high-carbon steel splice bars and extra high-carbon steel splice bars, structural steel for bridges, structural nickel steel, structural steel for buildings, structural steel for locomotives, carbon-steel car and tender axles, cold-rolled steel axles, staybolt iron, locomotive cylinders, magnetic tests of iron and steel, spelter, manganese bronze ingots and methods of testing.

During the past year the activities of the technical committees of the society were carried on with unabated vigor. Since the last annual meeting 401 committee meetings were held and 79 meetings of sub-committees, with a total attendance of 1,100. The total number of technical committees is 36. In a report to the executive committee, Secretary Edgar Marburg directed attention to a large increase in membership, which now totals 1,687, as compared with 1,574 at the last annual meeting. During the year 265 applications for membership were approved, but the total losses for the year from all causes numbered 152. The net increase therefore was 113, as compared with 115 reported last year for the preceding period of 15 months, and as against an average annual increase of 100 for the six years preceding the last.

Hunt Honored

It was announced that Robert W. Hunt, of Chicago, was elected vice president of the International Association for Testing Materials.

Papers and committee reports considered today follow: "Report of the Committee on Regulations Governing the Form, but not the Substance of Specifications", by Edgar Marburg, chairman; "Report of the Committee on Standard Specifications for Copper Wire", by J. A. Capp, chairman; "Report of the Committee on Non-Ferrous Metals and Alloys", by William Campbell, chairman; "A Rational Test for Metallic Protective Coatings", by J. A. Capp; "Method of Sampling and Analysis of Tin, Terne and Lead-Coated Sheets", by J. A. Aupperle; "Some Considerations Affecting Specifications for Wrought Non-Ferrous Metals", by W. R. Webster; "Study of the Strength of Non-Ferrous Castings, Including a Comparison of Different Test Specimens", by L. P. Webbert; "Are the Effects of Simple Overstrain Monotropic", by Dr. Henry M. Howe; "Relation Between Brinell Ball Test and Sclerescope Readings", by J. J. Thomas, and "A Critical Review of the Procedure Governing the Adoption of Standards", by Edgar Marburg. Several of these papers are published in this issue.



A. A. STEVENSON,
Vice President, Standard Steel Mfg. Co., Philadelphia

Dr. Henry M. Howe made a report on the work done at the Torin, Italy, meeting of the International Association for Testing Materials.

A resolution adopted was to the effect that the International Association for Testing Materials recommend the preparation of standard specifications for the delivery of materials of construction intended for international trade purposes. While the council realized the difficulties attending any attempt to unify existing specifications of the countries affiliated with the international society, nevertheless a distinct advance in international efficiency and comity is seen by the agreement upon standard specifications for export purposes. The 1915 congress of the International Association for Testing Materials will be held at St. Petersburg, Russia, Aug. 11 to 17.

In his annual address, A. N. Talbot, the retiring president, pointed out how the work of the society could be made more valuable by further encouraging scientific research. Prof. Talbot's address is published practically in full on the oposite page.

The New Officers

The new officers of the American Society for Testing Materials for the ensuing year are as follows: A. W. Gibbs, chief mechanical engineer, Pennsylvania railroad, Philadelphia, president; A. A. Stevenson, vice president, Standard Steel Mfg. Co., Philadelphia, second vice president; Edgar Marburg, Philadelphia, secretary-treasurer; Robert Job, Milton Hersey Co., Ltd., Montreal; F. W. Kelley, Helderburg Cement Co., Philadelphia; A. Marston, dean, Division of Engineering, Iowa State College, Ames, Iowa, and S. S. Voorhees, Bureau of Standards, Washington, members of the executive committee.

An animated discussion was precipitated over a suggestion to eliminate the letter ballot to members of the society on the adoption of specifications. This suggestion, which was made by Secretary Marburg, would make the action of the committees on specifications binding on the society. The suggestion was referred to the executive committee for final decision.

Employes of the Rosedale Foundry & Machine Co., Pittsburgh, enjoyed an outing last week at Conneaut Lake.

New Work for Testing Society

Annual Address of the President of American Society for Testing Materials at Atlantic City, June 30

BY ARTHUR N TALBOT

THE American Society for Testing Materials, in its 16 years of activity, has had to do with the methods of testing engineering materials—standardizing methods to produce uniformity in testing and to secure tests which would properly differentiate qualities and distinguish between acceptable and rejectable materials. The society has, therefore, discussed the desirable properties of materials, and naturally it has dealt largely with the qualities and defects and with the nature of the uses of materials, and with the requirements accompanying those uses. As one function of the society is to bring the producer and the consumer on common ground, the society has dealt with specifications and requirements for the material; definite, explicit and sane requirements, acceptable alike to producer and consumer, and these have come to form the basis for commercial contracts over the entire country. To secure the formulation and adoption of such specifications has involved an intimate contact between producer, consumer and unattached expert in ways that have in themselves resulted beneficially to producer, consumer, and expert, as well as to the society itself. In considering these activities of the society, it is apparent that the constructive work of the society must be based upon information—definite, trustworthy, complete information, on the properties of materials, their action under stress, load, and time, and in combination with other parts in a machine or structure. Obviously, to get hold of this information and to pass upon its value must be within the province of the society. The element of investigation is vitally connected with the activities of the society. It is to the question of research in engineering materials and the relation between research and the activities of the Society that I invite your attention for a brief time.

ARTHUR N. TALBOT

It is unnecessary in this audience to establish the need for definite, trustworthy and complete knowledge of the properties and actions of engineering materials. There was a time when general information, common belief, or even say-so opinion was all that was available for outlining specifications upon which material was to be purchased. Since the formation of the society, great advance has been made in our real knowledge of materials, very much of it being due to the activities of the society itself, and we are now where the value of the fruit of research is appreciated. As soon as the surface is scratched over, the need of systematic investigation becomes apparent. Ultimate progress involves a searching, critical, and thorough inquiry and investigation into the facts and principles relating to the subject. Real research lies at the basis of that complete and definite knowledge of the properties and actions of engineering materials that is so essential in the formulation of specifications for the selection of materials, and in the understanding of the nature of the resistance of the machines and engineering structures in which they are used; and more and more as time goes on will the Society need to avail itself of the fruits of research. Fortunately for us, the agencies for gathering knowledge and for conducting research are many and varied, and their number and opportunities are increasing. First in time, and in the past perhaps first in opportunity, may be named the producer or manufacturer. Next to the producer may be mentioned the consumer, whose interests in research should be as large or larger than the producer's, though neither of these agencies has always realized its investigational opportunities and responsibilities. The private laboratory of the consulting engineer, testing engineer, or chemist and the independent research institute constitute another agency. The various government laboratories, the engineering experiment stations, and the laboratories of engineering colleges and technological schools may be grouped together as still another agency. The list would not be complete without including an agency which has been especially productive in effective investigational work in the past few years, and which may be expected to render still more valuable service in the future—I refer to co-operative work by scientific and engineering societies and their committees in connection with producer, consumer, scientific laboratories and individuals.

There was a time when the knowledge of the properties of certain engineering materials emanated principally from the producer, or was even held by him as trade secrets. The manufacturer has special opportunities for learning the qualities of

his output—in certain directions at least. He needs to know something of its properties, for during the initial stage of business he must develop his product, and generally he must work to develop its field of usefulness and applicability in order that his business may grow to proper proportions. Competition compels him to know about his product and perhaps about the product of his competitor. There was a tendency then to withhold information; the brand of the established house was held sufficient as a specification. Time has thrown purchase by brand into disuse except for small purchases. The brand of a cement or of boiler plate still has selling value, but the producer must contract to deliver an article which will comply with definite specifications. Buying by specification is considered to be of great advantage to the consumer, for it permits of intelligent competition and gives an agreed statement of what properties are wanted, and is it not, therefore, advantageous to the producer also? Granting purchase by specification, knowledge of the properties of a material is of great importance to the producer. And the producer is in a position to learn about his product. He is on the job continually. His chemist and his testing engineer keep tab on the work and these trained and experienced men are able and willing to conduct researches to learn more of the material and of its action under varied conditions of service. A large amount of valuable investigation has been carried on by the producer.

The consumer is in a different position: He has to live with the material; he knows how it works, how it wears, whether it breaks and what the disastrous consequences are. He comes to think he knows what qualities he wants in the material, and he may ask for these qualities. The producer may have to tell him that it is not commercially practicable to make such a material or a product; and the incost would be prohibitive. The consumer may find that it will be to his advantage or to the advantage of his client, the public, to use the better material even at an increased cost, as in the case of the rail which reduces the chance for accident and loss of life. The consumer has many opportunities to learn the peculiarities of a material or a product; and the intelligent systematic record and analysis of failures or defects, of service and durability, add greatly to our knowledge of the properties of materials and may be made to form an even more important source of information. The laboratories of the consumer have been of great assistance in determining properties and in formulating adequate requirements, as is instanced in the work of the laboratory of the Pennsylvania Railroad Co., developed so highly under the leadership of our lamented former president, Dr. Dudley. But here again, with an increasing number of laboratories and with increased interest on the part of the consumer in the work of their laboratories, may we not expect, as the years go on, that the contributions to knowledge from these laboratories will increase many fold?

The next group, the private research laboratory, may at times serve the producer and at other times the consumer, in which cases it may be classified with the producer's and the consumer's laboratories; or it may serve as an independent research laboratory to investigate and report independently upon a research problem which is of common interest. This agency is also increasing in usefulness and we may expect its influence to grow with the years.

Government and college laboratories occupy an independent position. They enjoy the very full confidence of the public who feel that these laboratories are not connected with special interests and that research problems will be handled with judicial fairness and impartiality. These laboratories enjoy the further privilege of being able to devote time and money in researches into the principles of action and fundamental nature of materials, which are seemingly of remote applicability and do not appeal directly to the producer or consumer, but which finally, after a number of pieces of work have been completed and fitted together, may prove of intense practical value. Among these laboratories, the testing laboratories of the national government are rapidly assuming a place of inestimable value in the bearing of their work on the industrial and engineering interests of the country. A recent bulletin of the society named a number of these government laboratories which have expressed a willingness to co-operate with the committees of the society. The expansion of the Bureau of Standards in recent years is an instance of the growth of government testing, and presages something of future opportunities in investigations in engineering materials. In the field of college laboratories, there has been a development that may surprise those who have not kept informed. At least six engineering experimental stations have been organized in connection with the engineering departments of state universities. Research laboratories of similar purpose are connected with other engineering schools. Still other schools are doing investigational work in an informal way. From all these sources are coming contributions to engineering knowledge of great value in the form of bulletins and other papers. As these laboratories become better organized and their staffs acquire training and skill, is it not to be expected that this agency for research will become a powerful factor in the widening of our knowledge of engineering materials?

And now I come to the last of the research agencies to be named, one which I feel is most important in the work of the society, and one on which the future progress of the society greatly depends—co-operative work between the committees of engineering and scientific societies and the laboratories, facilities and store of information of the producer, consumer and independent laboratory. This form of activity takes advantage of the knowledge and experience of the man who is familiar with the processes of manufacturing and their peculiarities and limitations; of the man who knows the needs and the shortcomings of the articles in use; and of the unattached expert who may be able to help to correlate the views and interests of the other two. It gives breadth and depth to the scope of the inquiry and purpose to the method of testing. It assists in the analysis of data.

Other societies are using the co-operative agencies. Several recent reports of committees of the American Concrete Institute include valuable research material obtained in this way. The American Railway Engineering Association has utilized this agency extensively, though its most important research, that on rail, which is destined to put rail purchase and rail use on a new basis, has been carried on almost independently. In the work of the committees of the American Society of Civil Engineers, the extensive tests of steel columns now being carried out form an interesting example of co-operative work. Perhaps the recently constituted joint committee of the two societies last named formed to investigate the stresses in railroad track—rail, fastenings, ties, ballast, and roadbed—will prove to be the most extensive piece of co-operative work yet undertaken.

Research requires patience, diligence and skill as well as knowledge and opportunity, from outlining the problem and separating the essentials from the non-essentials to analyzing the data and drawing conclusions. See that men of ability and training are selected for such work. Express appreciation of the results obtained and encourage the extension of the work.

Power Questions in Steel Mills

First of Two Articles on the Application of Electric Roll Motors and Generation of Electric Power in the United States and Abroad

BY A DYCKERHOFF E E

THE LAST THREE decades have brought forth a development in the industrial world unsurpassed in history, and have also witnessed a complete revolution from the methods of manufacturing employed in the earlier part of this era. As a whole, this development of industrial life took place practically in the same period on the American and European continents or, to be more specific, in the United States and in the German Empire. While England was leading the United States and Germany in industrial activities up to about 1885, it has not kept pace with these two countries in various ways, particularly in the iron and steel industry. The enormous development of the latter can be seen from Table I, which gives the production of steel in tons for the three countries mentioned above. Since approximately 75 to 80 per cent of the steel production is rolled, it follows that about 42 to 45 million tons of steel were worked in roll trains in the year 1912 in the United States, Germany and England, of which 25,000,000 tons were rolled in this country.

These figures speak for themselves, indicating the importance of economy in driving roll trains to the steel industry and that the machine and electrical industries with their allied branches can, by means of a small increase in efficiency, contribute easily to decreased costs of production. It is plain that the rapid growth of the steel business gave these industries full opportunity for contemporaneous development, partly accelerated by competition. Thus it will be understood that the creation of three important energy transformers, viz., the blast furnace gas engine, the steam turbine and heavy electric power transmission, occurred practically only in the last ten years. This might be illustrated from the view point of heavy steel mill power application by the following:

Competitors of the Steam Engine

Up to about 12 years ago the steam engine was the only form of prime mover which had been developed to a high state of efficiency. As such, it supplied all power for general mill service, for roll trains, for small generators, for lighting and auxiliaries, When the steam engine had reached a high stage of perfection, the forceful development of gas engines and steam turbines set in, accompanied by the generation of electric energy and its application to heavy mill drives. The competition of gas engines, steam turbines and electric machinery with steam engines caused a further improvement of the latter, the latest development being the uniflow steam engine. While its steam consumption is said to be better than the tandem compound engine, its preference lies in its extreme simplicity. In general the position of the steam engine has been strengthened in recent years against the forceful progress of high pressure steam turbines, gas engines and electric drive by the utilization of its exhaust steam in mixed and two-pressure turbines.

The blast furnace gas engine was developed and ready for steel mill service in Germany about 1900, and a few years later in this country. While, up to a few years ago, units of but small capacity were available, at present twin tandem units of 6,400 brake horsepower and 94 revolutions per minute are in operation, and 3,200 brake horsepower tandem units. Due to the improvement of the thermal efficiency of the steam turbine and to its inherent overload characteristics, means for improving the gas engines were devised in Germany and the scavenging and surcharging processes

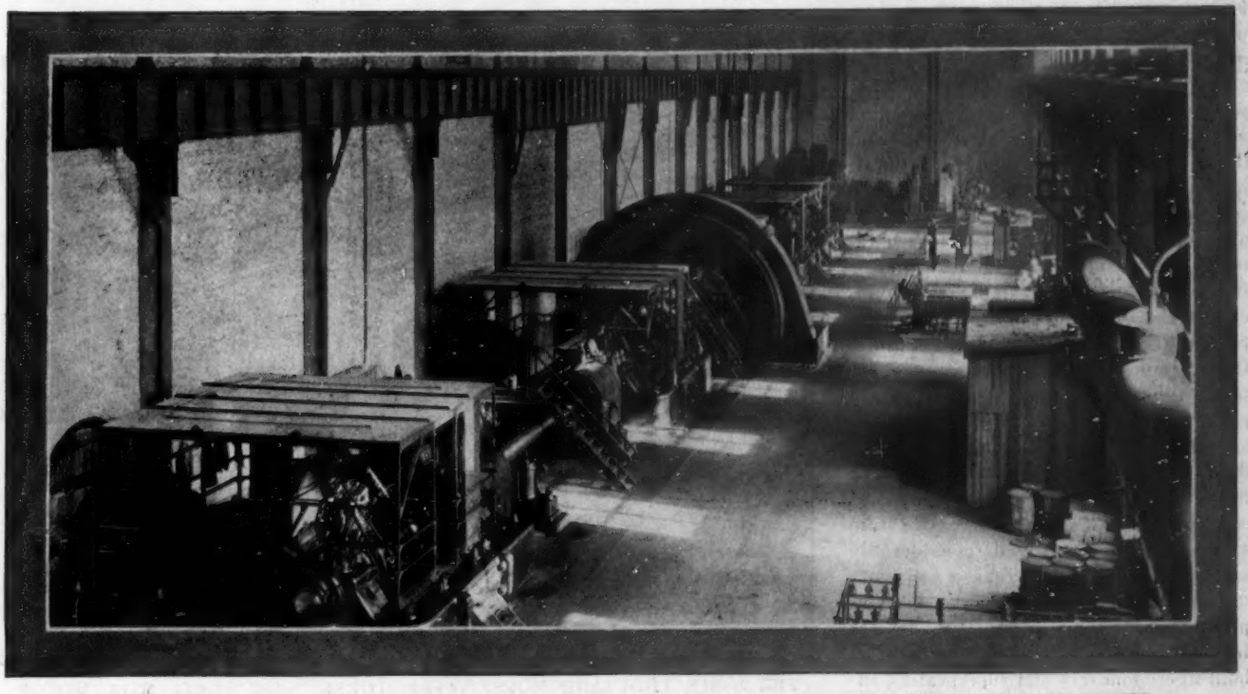


FIG. 1—GENERAL VIEW OF SOUTH MOTOR ROOM, BILLET MILL, ILLINOIS STEEL CO., GARY PLANT

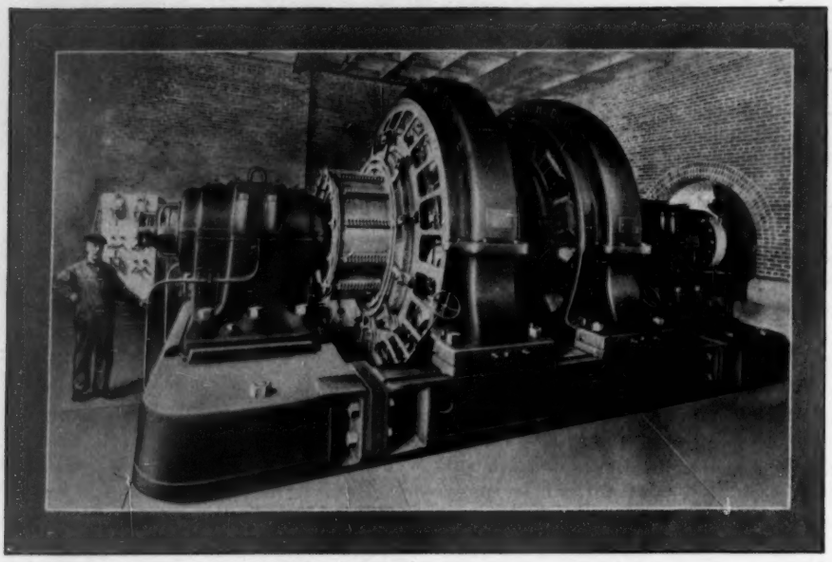


FIG. 2—FOUR THOUSAND HORSEPOWER REVERSING ROLL MOTORS

were invented with the result of increasing the nominal rating and the thermal efficiency. A further increase of the latter is accomplished by the utilization of the exhaust in boilers. The sisters of the blast furnace gas engine, the Diesel engine, built up to 4,000 horsepower, and the gas turbine, up to 1000 horsepower, have, to the writer's knowledge, not yet found application in steel mills.

No other prime mover experienced a more rapid development than the steam turbine. While we find small units of 1,000 to 2,000 kilowatts capacity in operation 13 years ago, there are at present turbines of 25,000 kilowatts capacity in operation and units of 30,000 kilowatts are under construction. The thermal efficiency of steam turbines has been increased by applying high steam pressures up to 192 pounds per square inch and highly superheated steam, 662 degrees Fahr. Another improvement of this type of generating unit has been achieved by increasing the speed for large units. In connection with steam regenerators (Rateau) and accumulators (Balcke Harle) the steam turbines have helped to increase the efficiency of steam engines, particularly of rolling mill engines. Other important machines of the rotary type, in other words, rotary pumps, blowers and compressors, have also been brought to a high stage of development during the period under discussion. Parallel with the marked improvement of the turbine, we find steam boilers improved considerably and their efficiency increased by many devices. Among such devices may be mentioned automatic stokers, devices for recording flue gas composition, built-in-economizers and superheaters, indirect and direct forced drafts, thus rendering "high output" boilers. By such methods, efficiencies of 83 per cent in coal and gas-fired boilers have been attained. A further increase of efficiency has been achieved by the so-called "surface combustion". Independent tests proved efficiencies of 93 to 95 per cent.

Growth of the Electrical Industry

The third companion of the steel and machine industries, in other words, the electrical industry, was given birth about 30 years ago and has outclassed, as to its rate of development, many other industries, due to its greater variety of product. Its supply to steel and iron mills up to about 10 years ago consisted mainly of small electric generating units for lighting, and small motors of the direct current railway type for such auxiliaries as cranes, live rolls, etc. There was no employment of heavy mill roll motors up to 10 years ago. The three-phase system was first introduced in steel mills in the Chicago district about 1903, and has since predominated in steel mills for large energy transmissions on account of its convenience and most economical form. The electrical manufacturers could, with the improved prime-movers, meet any demands the steel industry required, meanwhile assist in materially reducing the costs of manufacture. Thus it has occurred that with the tremendous increase of the application of electric energy in a few years, the generating power houses, units and motors have been built in very large ratings. Several electric power plants in steel mills are in operation with capacities of 20,000 kilowatts and more up to approximately 60,000 kilowatts. They are equipped with various types of prime movers. Up to the summer of 1913 the total number of electric roll motors built, or under construction, in the last decade, amounts approximately to 1,200, with an aggregate nominal rating of 925,000 brake horsepower designed for a maximum operating output of approximately 1,975,000 brake horsepower. These figures cover installations in America as well as in Europe.

On the American continent the first roll motor was put in service in 1906 in the Pittsburgh district, followed by the first electrically driven reversing mill in the Chicago district. Since that time, approximately 140 roll motors have been installed or are under con-

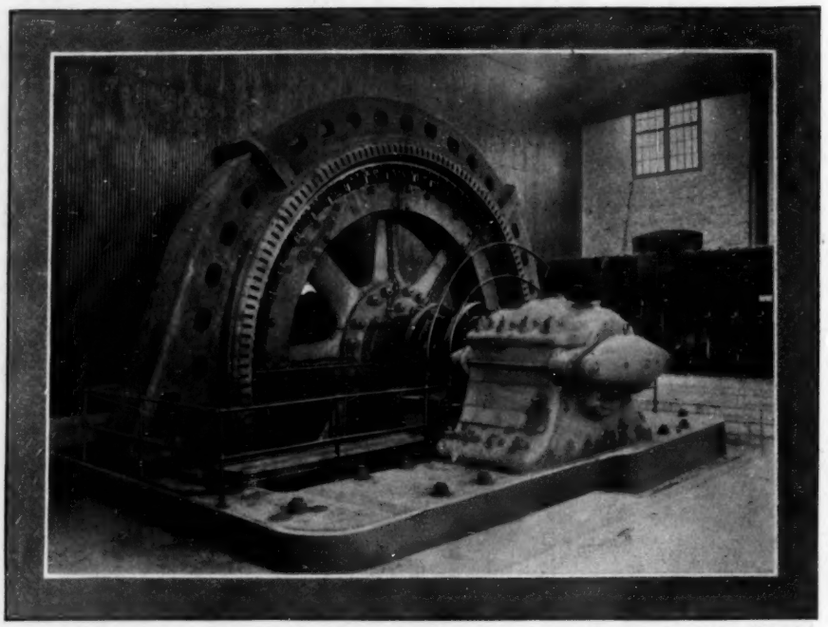


FIG. 3—SIX THOUSAND HORSEPOWER, THREE-PHASE PLATE MILL MOTOR AT GARY

struction on the American continent, with an aggregate nominal rating of approximately 176,500 brake horsepower and a maximum rating of 353,000 brake horsepower.

The rated capacity of single-roll motors has been brought in recent years to very high figures. Three-phase roll motors of 6,000 brake horsepower rating, built for a pull-out torque of approximately 20,000 horsepower, are in operation. A direct current motor as single unit with a maximum output of 20,000 horsepower is applied to a reversing mill. Altogether, there are approximately 50 electrically-driven reversing mills in operation or under construction, of which five are located on the American continent. The latest steps in the perfection of electric drive of roll trains are various methods of economical regulation of alternating current induction motors.

The above indicates briefly that the development of the machine and electrical industries coincides practically with that of the steel and iron industry in which the application of large electric roll motors and the generation of electric energy plays an important role. This fact is well borne out by the numerous installations in Europe and America in the last decade, and is sufficient reason for a study of the economic and engineering features of various applications and installations. Such a study will reveal the present tendencies and indicate the methods to be applied in line with the present status.

Practically all kinds of energy have been applied to the drives of roll trains. The steam engine dominated the field up to about 10 years ago, but has had, since that time, a rival in the electric roll motor which left the gas engine and steam turbine far behind. The gas engine has been applied to roll trains (sheet and merchant mills) in about four cases only, with outputs ranging from 1,000 to 2,250 horsepower. These drives were installed in Russia a few years ago, but have not found any advocates since on account of the inherent defects of such combinations. The steam turbine (high and low pressure Parson) has been adapted to a direct drive of roll trains in one instance only, in the Colderbank Steel Works, England. The turbine operates at a mean output of 750 horsepower and transmits its power to the roll train by means of a herringbone gear. The results are said to be favorable. Instead of the herringbone gear, the hydraulic gear of Foettinger has been lately applied in Germany. It is reported that a steam turbine driven roll train is under construction in this country. Water wheels, thus far, have not been applied to mill drives except for two European installations as prime movers of flywheel generating sets feeding electric roll motors.

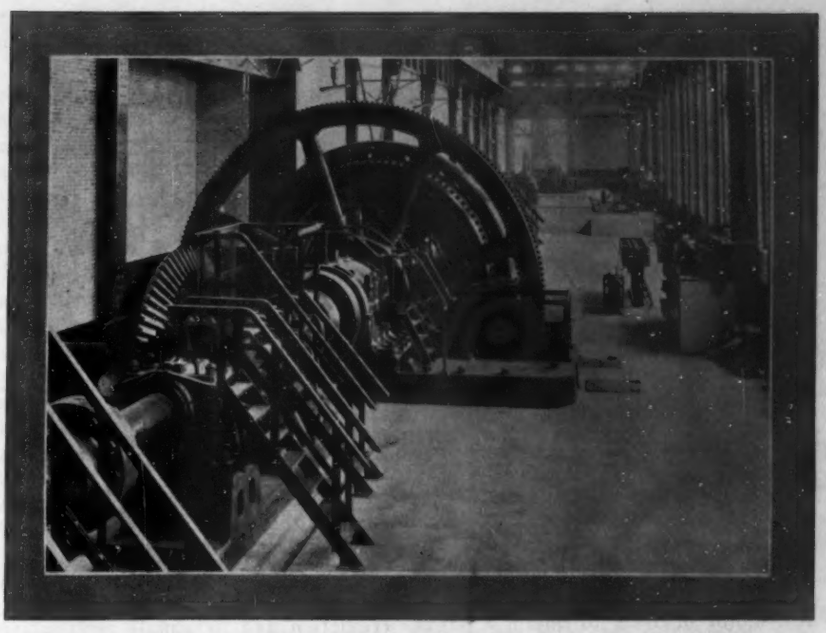


FIG. 5—MOTOR ROOM IN STRUCTURAL MILL AT SOUTH WORKS, ILLINOIS STEEL CO., CHICAGO

The noteworthy increase in number of electric roll motors in the last decade up to approximately 1,200, with a nominal rating of more than 900,000 horsepower, is certainly proof of the superiority of the roll motor drives above other types. The fact that the roll motor, even in its early stage of development, could withstand the severe mill service affords the evidence of utmost reliability. Simple in construction, it exerts its effort directly in rotative form in the most efficient way, and it requires but little space. The electric roll motor has helped to reduce the cost of producing rolled steel. It has made the extensive use of blast furnace gas and the centralization of electric power entirely feasible in steel mills. Thus the generation of electric energy is necessarily more economical and its transmission more efficient than with steam engines, particularly if there are several mills in the plant and if long pipe lines cannot be avoided. For these reasons, the superiority of electric drive is admitted generally in America and Europe, at least for all mills operating in one direction.

With reference to reversing mills, certain restrictions as to electric or

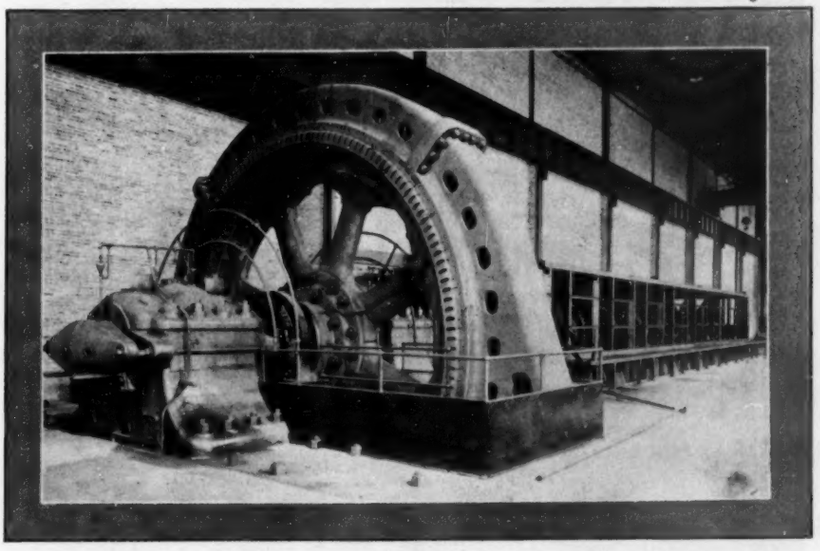


FIG. 4—SIX THOUSAND HORSEPOWER, THREE-PHASE, BAR MILL MOTOR AT GARY

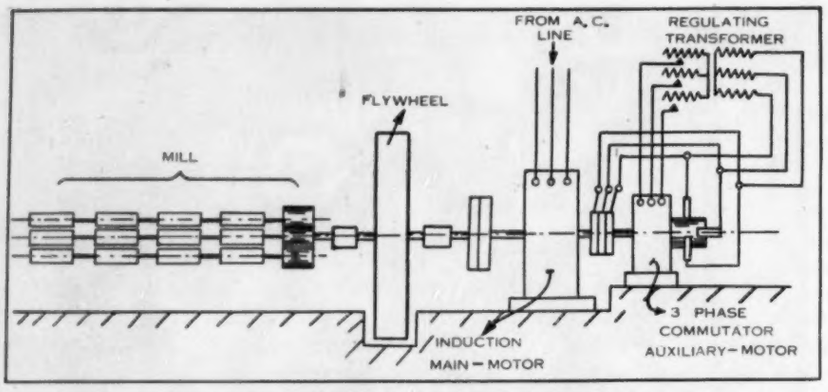


FIG. 6—ECONOMICAL SPEED ADJUSTMENT OF INDUCTION MOTOR BY MEANS OF THREE-PHASE COMMUTATOR MOTOR

steam drive may be made. It is well known that such electric drives usually require a motor-generator flywheel set in addition to the roll motor. Such a flywheel set must be interposed between the line and the roll motor in order to obtain a power demand at the line as uniform as possible. On account of such a flywheel set, the first cost of the electric drive is higher than with a steam reversing engine. While this is true it should be kept in mind that there is very strong evidence from tests made in Germany that the electric operation is more economical than the simple steam drive. The fact that approximately 50 electrically-driven reversing mills have been installed in Europe speaks for itself. In some German installations, besides other advantages gained, the first cost of the electric drive has been reduced by installing a flywheel set combined for several roll trains, one of which is arranged as a three-high mill without a flywheel and is usually operated as a true three-high running in one direction, but can also be used as reversing mill. The efficiency of the steam reversing mill engine can be increased by using mixed flow turbines but only at the expense of the first cost of the installation. In spite of the triple conversion of energy from the switchboard in the motor room to the roll necks, overall average efficiencies of 63 to 64 per cent in electrically-driven reversing blooming mills have been attained at full output. Since these losses contain the energy losses in the secondary resistance of the alternating current flywheel motor, caused by the slip, and since a part of the losses could be regained by methods discussed below, a further improvement of efficiency up to approximately 68 to 69 per cent could be achieved. The control of the electric reversing drive and its simplicity cannot be surpassed by any system for inherent reasons.

At the beginning of roll motor installations the direct current motor was more in favor and more generally applied than the alternating current motor. The advantages of the direct current motor are well known. They lie, mainly, in its economical speed regulation and its simple arrangement of compound winding for creating speed decrease for discharging the flywheel energy. All troubles arising from the commutator have been overcome and sparkless operation has been achieved mostly by providing the roll motors with interpoles and thereby making feasible a high overload torque up to 200 to 300 per cent.

With the growth of the power transmissions in steel mills, due to the limitations of the direct current system at low voltage and also to the economical transmission of the three-phase system, the three-phase roll motor soon outclassed the direct current roll motor. The good characteristics of the former are, simplicity, ruggedness and high pull-out torque. The only defect of the three-phase roll motor has been the speed regulation. To obtain an additional slip or speed reduction beyond its natural slip for a certain torque, resistance must be inserted in the rotor circuit. For the same amount of secondary resistance, the motor assumes a low speed at a high torque and a high speed at low torque, exceeding easily a value of speed variation which is permissible for the product and also a value which is very undesirable when such motors are driving continuous mills. These difficulties have been overcome by speed regulating devices to be discussed below. In America about 80 per cent of all roll motors are of the three-phase characteristic, while in Europe the proportion is 65 per cent.

Character of Load

The load imposed on the roll motor is of intermittent character in the extreme. The torque demanded from the motor may vary from friction torque of the mill (20 to 25 per cent of rated motor torque) up to 75 per cent above rated torque, depending on the roll train resistance and on the speed of various passes. Time elements of a fraction of a second may apply to the earlier passes and of several seconds to the later passes. Since the roll train resistance depends also on the quality of steel and its temperature, and the handling of the mill on the skill of operatives, other excess power demands may be introduced in the cycle of operation. Usually one motor is connected to a mill with several stands, the various passes of which are so timed, if possible, that they do not coincide. This may be expressed by the diversity factor

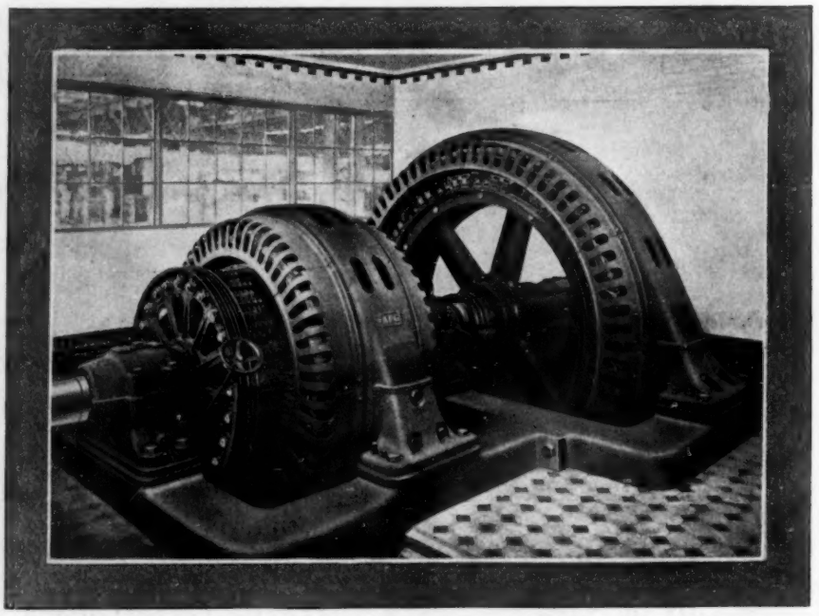


FIG. 7—ECONOMICAL SPEED ADJUSTMENT INSTALLATION IN A GERMAN PLANT

forming the ratio of average energy demand to the sum of the possible maximum energy demands of various passes. Thus by properly timing the passes, the variations of energy demand can be reduced to some extent. Likewise, the load factor over the cycle, in other words, average load divided by maximum load, can be increased. The cycle laid out for a certain class of product can be enforced pretty well with continuous and semi-continuous mills, but this can scarcely be realized with ordinary three-high mills. While, with merchant mills having many passes a fairly uniform power demand may be found, yet so many variables enter into the operation of roll trains that the service required from the roll motors is more intermittent and severe than that of any other application known to industry.

Rating of Roll Motors

The question of efficiency is very much involved in the shaping and cycle of the load curve for certain roll trains, for the following reasons: The nominal rating of a roll motor is generally based on the "root mean square" value of the current corresponding to the torque demanded by the roll trains, which value determines the heating of the same. But the rating is not to be based on the average demand over a cycle. At the same time a maximum torque, which can be expected under consideration of the interaction of the flywheel, is to be carried by the roll motor. This torque, including a certain safety factor, determines the pull-out torque required of the motor. If the maximum demands of the various passes coincide, the heating of the motor will be considerably higher as it varies with the second power of the current. Therefore, a motor of a higher rating must be selected, resulting in high first costs. Thus the highly rated motor will operate at low average load conditions resulting in low efficiency, and low power factor, which reduces the available capacity and efficiency of the generating units. The requirement of a certain minimum pull-out torque in the roll motor, especially of the induction type, can generally be met with little difficulty. It has become practically a universal standard to demand that any roll motor can carry an overload torque of 100 per cent in excess of the normal (nominal) torque, and to have, consequently, a pull-out torque above this limit. For such reasons, great attention should be paid to the shape of the load curve, and the rating of the motor in order to avoid "over-powered" mills and to gain the full benefit of the economical electric drive.

Hand in hand with the determination of the roll motor rating, the question of a suitable amount of rotating masses connected to the roll motor and their interaction is to be considered. At any variable energy demand, it is an engineering principle to provide for an energy reservoir to give up kinetic energy whenever excess energy demands occur and to store energy when excess energy is available at the source of motive power. The flywheel offers the simplest means of storing and discharging energy, hence practically all motor-driven roll trains must have a certain amount of flywheel effect. The proper selection of the flywheel has an economical side, since it decreases the maximum energy demands on the motor and thereby its rating and raises the load factor with the result of reduction of first cost. Furthermore, it improves the power factor and the efficiency of the motor, thus bettering conditions in the power plant.

Usually any rolling mill comprises several roll schedules which impose on the driving mechanism different loads. While motor and flywheel properly can be suited for but one schedule only with a given secondary resistance and slip, economical conditions can be conserved by deliberate and intelligent slip adjustment. Certain energy must be delivered by the wheel and stored again within a cycle, the amount of energy being dependent on the moment of inertia of rotating masses and the difference of the squares of speed or slip. Since the slip entails losses in the secondary of the motor, which should be cut down as much as possible, it has been found that the slip in general practice should not exceed 10 to 15 per cent of synchronous speed irrespective of permissible speed reduction on the roll train. This limit of 15 per cent may be increased to 20 per cent when applied to Ilgner sets. With limits to the drop of speed, means must be provided to obtain a large moment of inertia and also a large radius of gyration. The alternative is high rotative speeds in order to have the necessary energy storage and involves the concentration of mass as near the rim as possible. It frequently necessitates special construction of the wheel. In such cases disc-wheels of laminated steel plates riveted together are applied in America with peripheral speed up to approximately 23,000 feet per minute. While the material of such a wheel is not always distributed efficiently with reference to a large radius of gyration, yet the same offers greater safety on account of the absence of cast steel parts subjected to the high centrifugal forces. In Germany, flywheels of compressed steel casting are usually applied in connection with motor-generator sets, and with peripheral speeds up to 26,000 feet per minute. In some cases the flywheels applied to motor-generator sets are running in a vacuum in order to minimize the windage losses.

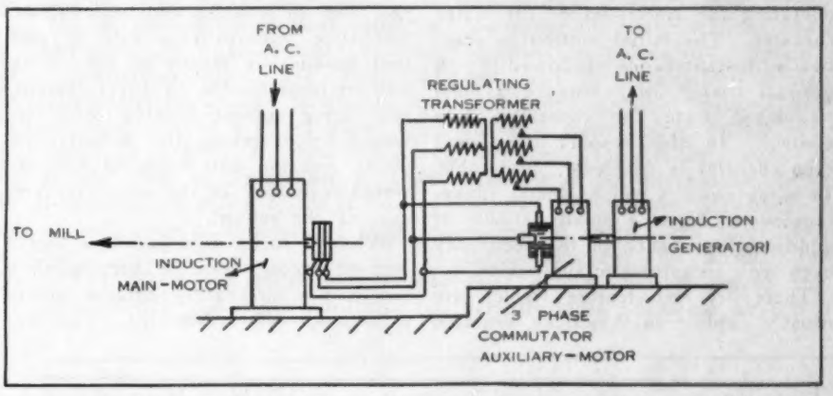


FIG. 8—ECONOMICAL SPEED ADJUSTMENT OF INDUCTION MOTOR BY MEANS OF REGULATING SET

Control of Motor

An essential feature of any roll motor equipment is the control of its primary and secondary circuit in which question there is considerable difference in American and European practice. The former applies practically in all cases a system of alternating current or direct current operated contactors in conjunction with grid resistances for the secondary motor circuit. A master controller operates these contactors and the oil circuit breaker in the primary. In Europe, particularly in Germany, water rheostats are mostly used in the rotor circuit and the oil circuit breaker for the primary is operated independently. While each system has its merits, yet there is an important point to be ob-

served with any system which is as follows: Quick action of the slip device for introducing resistance in the secondary circuit is necessary so that the flywheel can take care of the peaks on the roll motor. This is particularly important on mills with peaks of very short duration. The slip device is automatic, in other words, the device changes the amount of resistance in the secondary of the motor automatically in relation to the current flowing into the motor. The automatic action is obtained with the contactor type control by relays and contactors, which agencies must consume a certain time to place the resistance in the secondary of the roll motor. The time is approximately 0.25 of a second. It is evident that such an action is frequently too slow for short passes, and peaks must be imposed on the line.

With the liquid type rheostat the automatic device consists of a small series transformer and a small motor operating the electrodes of the water rheostat. The initial motion is practically instantaneous, followed by a gradual change of resistance as distinguished from the contactor type control. In this respect the liquid type rheostat is decidedly preferable. In many cases it will be found advantageous to leave a small amount of additional resistance in the secondary even with an automatic slip device.

There are two features which are usually applied in American practice, but scarcely ever in European installations, and these are: First, breaking, and second, reversing of the roll motors if running in one direction. This is possibly an important element if the mills are very busy and not much time is to be lost in case of breakdown. For such conditions, braking and reversing features help considerably to locate and remove the cause of troubles and to cut down lost time. Generally it can be said that braking by means of alternating current is preferable to direct current, alternating current braking being effected by reversing the direction of phase rotation and reducing the external resistance in the secondary circuit of the motor.

While a speed adjustment of direct current motors can be accomplished easily, the alternating current induction motor offers difficulty. The rheostatic speed regulation of the latter can be satisfactory within certain limits, 10 to 15 per cent, from the standpoint of operation and efficiency. The refinement in the art of rolling steel and the imperative reduction of the costs of production of rolled steel through most efficient operation urges the adoption of the most efficient agents and methods of motive power. Merchant mills with a wide range of work require speed adjustment, particularly mills rolling high grade material. Quality of metal and finish of product make certain speeds necessary. For large mills with only one class of product, a so-called constant speed motor will generally answer its purpose perfectly.

Table I.

PRODUCTION OF STEEL SINCE 1883

Year.	United States tons.	Germany including Luxemburg tons.	England tons.
1883	1,708,865	859,813	2,041,624
1900	10,382,069	6,645,869	5,130,800
1912	31,751,323 or 18.5 times the production in 1883	17,301,998 or 20.2 times the production in 1883	7,000,000 Approximate excluding wrought iron or 3.42 times the production in 1883

If but two speeds are required by the mill, one of which is half of the other, then a simple multi-speed motor can be applied to advantage. Its coils can be grouped easily to give a speed adjustment of two to one at a slight increase of first cost. For any other speed adjustments, it is necessary to arrange the motor for two separate windings. The intermediate steps, of course, can be obtained by rheostatic control. The disadvantages of such a multispeed motor may be summarized as follows:

First—The power factor is lower than with one motor with one winding.

Second—Complexity of switching arrangement.

There are but few installations of multispeed motors driving roll trains.

A further method of obtaining speed regulation is the application of motors with separate magnetic and electric circuits in the form of two induction motors wound for different numbers of poles, and mounted on one shaft. The secondary winding of one motor is connected with the primary of the second motor. The motors can be arranged so that they may be operated singly or in concatenation, and also with rheostatic regulation. The power factor with such an arrangement is poor at low speeds, due to under rating of the individual mo-

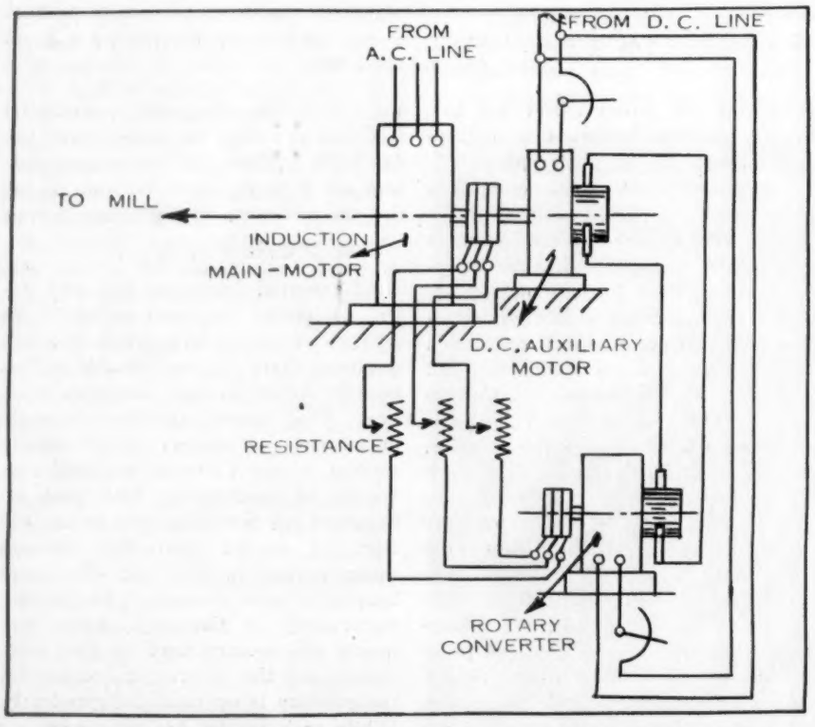


FIG. 9—ECONOMICAL SPEED ADJUSTMENT OF INDUCTION MOTOR BY MEANS OF ROTARY-CONVERTOR AND DIRECT CURRENT MOTOR

tors. With such motors it is not necessary to open the primary circuit when changing over from one speed to another. Concatenated roll motors have found application in very few mills.

There is another arrangement of motors driving roll trains applied in several instances in a steel mill in Europe. This arrangement consists of two induction slip ring motors of the same output but wound for a different number of poles and are thereby of different speeds. The motors are mounted on the same shaft. Only one motor supplies the necessary torque at its individual speed, while for another roll schedule requiring another speed the second motor will drive the mill at its individual speed. The disadvantages of such an arrangement are high first cost and that only two definite speeds are available, all other speed regulation being obtained by rheostatic control with its defects. The advantage is founded on good efficiencies and power factors of the individual motors when being operated without rheostatic control.

The alternating current commutator motor has been developed in recent years, its first appearance being about 20 years ago. It is in the nature of rolling processes that motors with compound characteristics in connection with flywheels are most desirable, and consequently series type commutator motors have little prospect of application. At present the alternating current commutator motor is limited in its output, and is, as a single motor, therefore, out of the question for heavy rolling mill applications. It can render good service for small special mills, bending rolls, etc. There are few small installations in Europe.

The limitation of the efficient speed adjustment of three-phase induction motors has led, in recent years, to the development of several very ingenious devices for this purpose. While it is not possible to mention all of the numerous devices in this line, it will be sufficient to show their typical differences, and to restrict this study to those which have found actual application in connection with roll trains. These devices may be classified as those which transform energy taken from the rotor of the induction motor into mechanical energy (1-a and 1b below) and those which transform the rotor energy into another form of electrical energy (*2-a* and *2-b*).

Table II.

COMPARISON OF REGULATING SYSTEMS

25 Per Cent Regulation Obtained by

	Rheostatic control	Three-phase commutator motor system 1-a	D. C. motor system 1-b	Regulating set system 2-a	Frequency changer system 2-b
Power factor	0.79	0.98	0.98	0.98	0.98
Efficiency	71 per cent	88 per cent	89 per cent	84.5 per cent	85 per cent

(1-*a*) The energy taken off the rotor of the induction-main-motor is consumed by a three-phase commutator-auxiliary-motor and converted into mechanical energy. The main and auxiliary motors are connected mechanically either rigidly or by gear or belt. Such an arrangement is shown diagramatically in Fig 6, and a view of an installation of this kind is given in Fig 7.

(1-*b*) The energy taken off the rotor of the induction-main-motor is converted into direct current by means of a rotary converter feeding in turn a direct current-auxiliary-motor connected mechanically to the main motor. This case is illustrated in Fig. 9.

(2-*a*) The energy taken off the rotor of the induction-main-motor is supplied to a three-phase commutator motor driving an induction generator feeding back to the line. There is no mechanical connection between the main motor and regulating set. This arrangement is shown in Fig. 8.

(2-*b*) The energy taken off the rotor of the induction-main-motor is converted into the line frequency and voltage by means of a frequency-changer and transformer and is fed back to the line, as illustrated diagramatically in Fig. 10. The frequency changer may be connected with the induction-main-motor either mechanically or electrically.

In the selection of any of these systems, the service of roll trains should be borne in mind. Generally, the rolling process requires high torque at low speed for heavy sections and also for the first passes of a certain section, and it requires low torque at high speed for light sections and for the last passes of a certain section. Therefore, the rolling mill is a constant output proposition, in other words, the torque increases with decreasing speed. For these reasons, the systems 1-*a* (for a small range) and 1-*b* (for a wide range) are inherently more adaptable for roll train

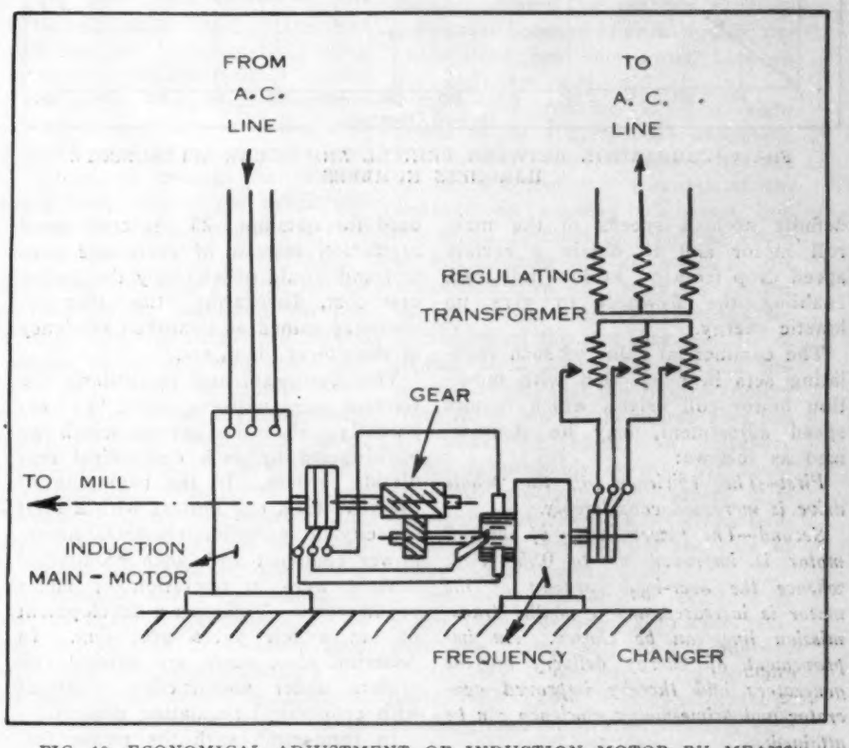


FIG. 10—ECONOMICAL ADJUSTMENT OF INDUCTION MOTOR BY MEANS OF FREQUENCY CHANGER

service than 2-*a* and 2-*b*. The former also permit the selection of a somewhat smaller main motor. Nevertheless, all systems supplement each other since, for electrical reasons, with the present state of the art, system 1-*a* can be adopted for a certain range of speed regulation and output of the auxiliary motor as a three-phase commutator motor. System 1-*b*, however, requires a certain minimum speed regulation to the effect that the rotary converter can operate free from hunting. Thus, under certain conditions, systems 2-*a* and 2-*b* prove very suitable for rolling mill drives. They may then decrease the first cost and offer the possibility of a remote location of the regulating sets, if imposed by congested mill construction. With any system it is feasible to adjust various

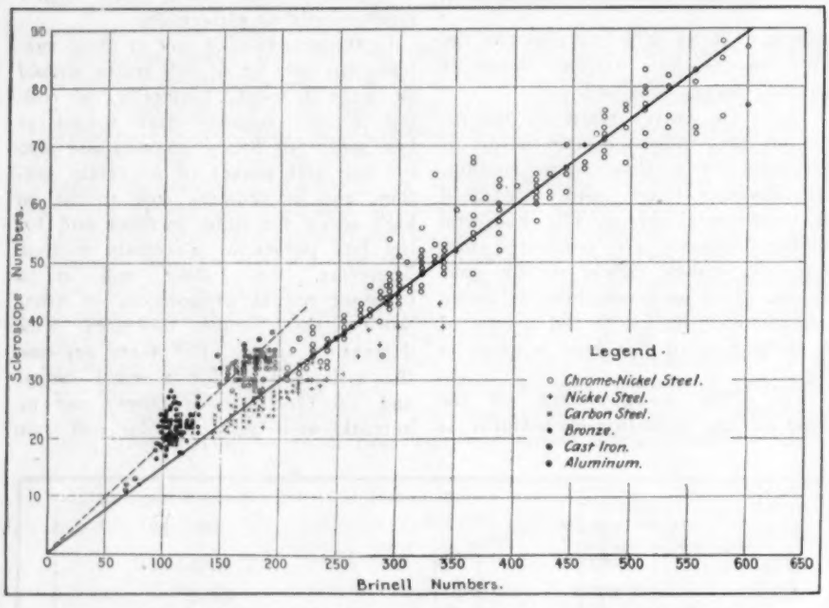


FIG. 1—COMPARISON BETWEEN BRINELL AND SHORE SCLEROSCOPE HARDNESS NUMBERS

definite no-load speeds of the main roll motor and to obtain a certain speed drop from no load to full load, enabling the flywheel to give up kinetic energy.

The commercial value of such regulating sets in connection with induction motor roll drives, which require speed adjustment, may be summarized as follows:

First—The efficiency of the whole drive is increased considerably.

Second—The power factor of the roll motor is improved up to 0.95 *or* 1, *whence the over-load capacity of the motor is increased and a smaller transmission line can be chosen. An improvement of energy delivery on the generators and thereby improved generator and prime-mover efficiency can be attained.*

Third—There is an improvement in the quality of the product.

For comparison of the various systems, Table II has been prepared giving average figures of efficiency and power factor for a motor of 1,100 horsepower at 300 revolutions per minute and 25 per cent speed regulation.

The savings which can be obtained may be illustrated for an installation of a small merchant mill driven by a 1,000-horsepower motor for an output of 6 tons per hour. If the mill is in full operation 6,000 hours per year and 25 per cent speed regulation is required, one-half of that time the saving of power will amount to approximately $2,500 at the motor if the kilowatt-hour is valued at 0.6 cent. This saving could be made if a regulating device such as 1-*a* or 1-*b* were used for obtaining 25 per cent speed regulation instead of rheostatic control and would offset easily the higher first cost, disregarding the other advantages gained as improved efficiency in the power plant, etc.

The European, and particularly the German steel mill engineers, have apparently realized the savings which can be obtained by such economical regulating devices. In the beginning of the year 1913, roll motors with a total capacity of approximately 45,000 horsepower equipped with such economical devices were in operation or under construction. This was a development of but a few years preceding. In America, also, there are several roll motors under construction equipped with economical regulating devices.

In connection with the power factor correcting effect of the above regulating sets, mention should be made of synchronous condensers (or motors) and of the so-called phase-advancers, both having the property under certain conditions of improving the power factor. Of these two, the synchronous condenser only has found application in some steel mills, chiefly in America.

(*To be continued.*)

Hardness Tests

By J. J. Thomas

A number of inquiries have recently reached Watertown arsenal as to the proper factor to convert Brinell ball-test hardness numbers to scleroscope readings. Many manufacturers and laboratories have one of these instruments, but few have both. In order, therefore, to compare the hardness of their product with that of another factory or to interpret the results given in various papers and journals, it is necessary that the factor connecting the two be known.

The curves shown in Fig. 1 were plotted after taking over 500 readings. All Brinell impressions were made with an "Alpha" machine having a steel ball 10 millimeters in diameter, with a pressure of 3,000 kilograms for 30 seconds. The scleroscope readings were taken with a Shore instrument, having a diamond-tipped hammer.

Different metals have been given different symbols in order that the relative hardness may be quickly noted. The full line gives the relation for steels, and is believed to be a representative curve. For this line the factor is 6.67; that is, the scleroscope reading multiplied by 6.67 gives the Brinell-ball hardness numbers.

It was found on plotting the values for cast iron and bronzes that all points were above this line. The broken line shown was therefore plotted, giving a factor of 5.25 for these metals. The three points for aluminum lie between these two lines, giving a factor of about 6. The points for nickel steel lie below the full line, and for these the factor 7.7 seems more suitable.

From the above it is seen that the factor is not constant, but varies with the different metals. In fact, considerable variation is found even in the same metal. The scleroscope readings vary more than the ball tests, probably due to the fact that the

(*Continued on page* 48*b*)

Paper presented at annual meeting of American Society for Testing Materials, at Atlantic City, June 30 to July 3.

A Study of Simple Overstrain

An Investigation of the Properties of Steel to Determine Whether the Effects of Simple Overstrain are Monotropic

BY HENRY M HOWE

GOING BEYOND the two general conceptions that the effects of overstrain may be either (1) isotropic, identical in degree and sign in every direction, or (2) not isotropic but anisotropic, we may distinguish for discussion two cases among the many conceivable forms of anistropy, (3) one in which the overstrain strengthens the metal against later stress in the same direction but weakens it against such stress in the opposite direction, and (4) one in which it strengthens the metal in all directions, though to a degree which varies with the direction of that later stress, being greatest for stresses which are in the same direction as the overstrain itself. Items (3) and (4) are special forms of monotropy and pantropy respectively, names which, as a temporary expedient, I shall use in this paper for brevity and precision, cautioning the reader of this artificial and temporary restriction of the meaning of these two words.

Though the effects of the overstrain which occurs in connection with repeated reversals of stress may be clearly anistropic, there is much to indicate that some at least of the effects of a single overstrain are isotropic. In what follows I discriminate sharply between overstrain which is, and that which is not, preceded by stress reversals in excess of the elastic range, such for instance as occur in the endurance test, or in an unduly loaded piston rod or crank shaft.

The anisotropy of overstrain in connection with reversals of stress is illustrated by the fact that, after the so-called "natural elastic limits" of Bauschinger, equal in compression and tension, have been established by alterations of equal tensile and compressive hyper-elastic stresses, the proportionality limit in tension can be raised and that in compression simultaneously lowered by changing the range of these alternations from equal tension and compression to greater tension and less compression, indeed to the last tensile and compressive stresses respectively reached in those alternations.

From this unquestionable anisotropy thus set up by stress reversals, it seems to have been inferred currently that similar anisotropy is true not only of unreversed overstrain in general but even of single applications of overstrain. Indeed one of the most learned and brilliant of the investigators in this field has lately said that, in overstrained steel, "the hardness is in reality limited to the particular direction in which the strain has been applied."

Effect of Stress Reversals

Stress reversals seem to affect profoundly the influence of overstrain. Thus, though most of the effects of overstrain uncomplicated by prior stress reversals are explained satisfactorily by Beilby's theory of amorphous metal, these stress reversals seem to introduce some very complicating phenomena which that theory in its present form seems wholly incompetent to meet, so that it now needs an important amendment or extension.

An illustration of this complicating influence of prior stress reversals is that, whereas simple overstrain raises the yield point very closely to the overstraining stress, and if followed by sufficient rest or by gentle heating raises the proportionality limit beyond that stress, yet when such overstrain is preceded by stress reversals, then even if followed by a competent heating, instead of raising the proportionality limit beyond the overstraining stress it may fail to raise it even to that stress.

Annealing seems to remove the effects of reversing overstrain far less fully than those of simple overstrain. To anneal in wire-drawing, cold-rolling or other form of simple overstrain, removes practically completely the effects of the overstrain which has thus far occurred, and in this way systematic repetitions of annealing enable us to increase the reduction of area indefinitely. If annealing had a like effect on reversing overstrain, then systematic annealings would increase the endurance indefinitely. Of course, in order to be effective they should begin before cracks have actually started, and should be repeated. Ideally, each annealing might be so applied as to increase the endurance one fold, so that six annealings would increase it 600 per cent; and though such ideal conditions cannot be closely approached, yet the increase of endurance by repeated annealings ought to be very great. But among 17 of Howard's cases, assembled by him in 1890, in which there were from six to eight annealings, beginning early in the endurance test, the average increase of endurance was only 60 per cent, the maximum increase was 210 per cent, and in four of the 17 cases the repeated annealings were followed by a loss of endurance.

In one case five like specimens were tested for endurance, one without annealing, the others with six annealings each, during the progress of the endurance test. In all but one of these tests the annealings lessened the endurance slightly, and in that one the net gain by the six annealings was only 3 per cent, or within the limits of error. It is true that he usually found much greater endurance when the test pieces were between 100 and 370 degrees Cent. than when they were artificially cooled with a stream of water. In the case of seven "Gautier" steels the increase of the endurance caused by running at temperatures between 166 and 245 degrees Cent. was very great, between 2½ and 18½ fold.

Such hot running at first sight seems to be a continuous annealing. Unwin, too, found in several but not all cases a moderate increase of endurance on running his tests hot. He seems inclined to refer the effect of hot running not so much to the temperature of the tests as to the cooling down at night, perhaps inferring, from the fact that the rate of cooling from above Ar1 has an important effect, that the rate of cooling from these low temperatures also has an important effect, an inference which is probably wrong. At these sub-transformation temperatures it is the length of exposure to given temperature that counts, not the rate of change of temperature.

But the whole of this evidence is inconclusive, because Howard's temperatures, rising only to 320 degrees Cent., may cause not annealing but stiffening. There is ample evidence to show that moderate reheating, certainly to above 300 degrees, raises the elastic limit of overstrained steel;

Portions of a paper read by Dr. Howe at the annual meeting of the American Society for Testing Materials at Atlantic City, June 30-July 3.

indeed industrial processes are based on this. Were the effects of repetitive overstrain identical with those of simple overstrain, then such heating would be expected rather to hasten the elevation of the elastic limit caused in the endurance test. Evidently further experiments are needed to show the effect of a true annealing on the endurance.

Difference as Regards Prior Overstrain

Though simple overstrain followed by rest raises the tensile strength, yield point, and proportionality limit, and though these effects are repetitive and cumulative, repeated tensile overstrains even when pushed to rupture raising these properties higher and higher, yet there is much evidence to show that the overstraining stress reversals of the endurance test, whether pushed to actual rupture or not, do not raise these properties to any comparable degree.

Indeed there is much evidence to show that reversing overstrain, instead of adding to any initial elevation of the elastic limit and tensile strength caused by prior overstrain, as simple overstrain does, for example, in wire drawing and cold rolling, has the opposite result of effacing the effects of such overstrain. If this is true, then it follows that any rise of the tensile strength and elastic limit caused by prior overstrain is fictitious as regards the endurance of stress reversals, and that the effective fatigue strength is that which existed before such prior overstrain, and hence that to which the metal would return on removing that overstrain by annealing at 600 degrees Cent.

Tensile rupture increases the Brinell hardness of low-carbon steel by about 40 Brinell numbers in Mesnager's results. Wire drawing has a much greater hardening effect, — between about 80 and about 145 Brinell numbers in Goerens' data.

Should Engineering Specifications for Unhardened Reverse-stress Objects be Based on Annealing at 600 Degrees Cent.?

If it is true that stress reversals efface the elevation of the elastic limit due to prior overstrain, for example, that caused by cool-rolling or forging, by quenching stresses, etc., then it seems to follow that engineering specifications for objects which in use are subjected to numerous stress reversals should ignore such elevation, and hence that this elevation should be effaced in the test pieces which testify to the fitness of the metal. This effacing, according to our present evidence, is effected fully by a simple heating to 600 degrees Cent., which, if not unduly prolonged, ought not to cause any other important change in unhardened steel, such as de-sorbitizing that which has been heat-treated skillfully. Such a 600-degree heating of course could not apply to steel which had been hardened and partly drawn, such as spring steel, because it would complete the drawing, and thus substitute the annealed for the tempered state sought. Nor would it be needed for heat-treated axles and like objects, for any usual heat treatment itself would do that very effacing of prior overstrain which the 600-degree heating aims to bring about.

Is the elevation of the proportionality limit by cool-rolling, forging, etc., fictitious as regards stresses which, though varying within wide limits, yet remain constant in sign? I interpret Bairstow's evidence as arguing that it is.

Phenomena Suggesting That the Prior Elevation of the Elastic Limit Persists

The hypothesis that stress reversals, if carried beyond the natural elastic range, efface the elevation of the elastic limit caused by prior overstrain, implies that hard-drawing and other forms of overstrain do not increase the elastic range under such reversals; that for instance, the gold springs of pincenez eye-glasses, the shanks of a dentist's cutting tools, knitting needles, etc., which in use are subjected to stress reversals, are not more elastic because of being worked cold into shape, an implication which is contrary to common observation. We know that they are far more springy, and apparently persistently springy, because of that cold-working, that is, because of that overstrain.

But if any cycles which exceed the natural elastic range of the unoverstrained steel efface the overstrain, then such wire-drawn objects should have no higher elastic limit, and in that sense should be no stiffer as regards the angle they can bend without setting than like material annealed.

In like manner the hypothesis that stress variations which remain constant in sign efface the stiffening effect of such prior overstrain, would inply that the hard-drawing of wire for bridge cables and for pianos makes it no stronger for resisting its cycles of stress, an implication equally opposed to common observation. We know that hard-drawing increases the stiffness, strength and springiness, and that this increase persists after very many repetitions of the cycle of stress.

It may be that this persistence of the effects of overstrain during repetitions of stress, both with and without change of sign, is only temporary. Thus Bairstow found that only after some 8,000 repetitions of stress between —8.3 and +18.3 tons per square inch did any permanent set arise which could be detected even by his delicate methods, that is, did an effacement of prior overstrain reveal itself. Moreover, the effacement of such intense overstrain as exists in hard-drawn wire may be even more slow and gradual than that of the very moderate initial overstrain of Bairstow's materials.

At least we have reason here to suspect that the laws of this effacement of prior overstrain are yet to be discovered. Is the evident greater stiffness of the hard-drawn state truly permanent, persisting through an indefinite number of stress cycles, or has it a life, so that it is effaced gradually by such cycles? For the 8,000 cycles which were needed in Bairstow's case to develop any detectable loss of elasticity in his initially only slightly overstrained steel, shall we read millions or billions of cycles needed to lessen materially the extreme overstrain caused by wire-drawing? Hoisting cables may well be worn out before the harmful number of cycles has been passed. But with the more permanent bridge cables, is the number of cycles needed to cause serious effacement of overstrain so vast that the life of these cables is not of decades but of centuries?

Circumstantial support of Bauschinger's hypothesis is given by Bairstow's late researches, in which he showed that the elastic range during stress cycles followed a curve of the same family with that of Wohler's curves of the safe range under like stress cycles. This resemblance seems to have been interpreted in general as proof that the elastic range and the safe range are identical, and hence as a confirmation of Bauschinger's hypothesis. But it seems to me not confirmation but only strong circumstantial support. Accepting Bairstow's results at their face, they prove that, with varying minimum stress limit, the safe range is parallel with the elastic range; but because his materials are not known to correspond closely in their natural elastic limits to Wohler's they do not prove that these two ranges are identical, though they increase the probability of that identity very greatly. Beyond this, Bairstow's results do not command complete acceptance as quantitatively accurate.

They were reached by extrapolation, under difficulties the gravity of which he frankly admits.

I disclaim expressly any conclusion as to whether repetitive stress beyond the primitive elastic limit does or does not efface the strengthening effects of prior overstrain. Indeed I point out that the indications that it does are sufficiently important to call for thorough study of the question, whether that strengthening is or is not fictitious for services implying indefinite repetitions of stress.

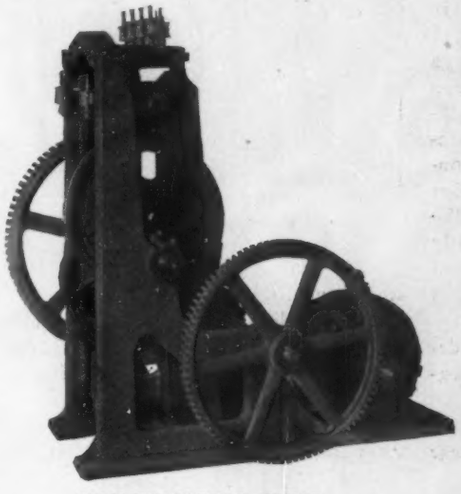
Evidence That the Effects of Simple Overstrain are not Monotropic

Though the tensile stress which causes a tensile overstrain is applied lengthwise, yet in that it causes a reduction of area which is a function of the elongation in any given section, it is in effect transverse too. In each grain, as it elongates, the crystal units slide in a plane parallel to two of their axes, a plane which can only exceptionally be parallel to the pull. The travel of all but an insignificant proportion of these units has a component transverse to the pull, so that some transverse effect of the overstrain is expected with confidence.

A hard-drawn wire is stiff in every direction, for example, against bending, and apparently strong against both tension and compression, because its bending resistance is composed of the tensile resistance of the convex and the compressive resistance of the concave side. If it were weakened compressively just as much as it is strengthened tensilely, then it should be no stiffer against bending than before the wire-drawing, which is untrue. Of course, some quantitative difference between the strengthening in the direction of the overstrain and that in the opposite direction may remain, if not in a drawn wire which in drawing is both compressed laterally and elongated tensilely, at least in a wire torn tensilely without lateral compression. The familiar properties of cold-rolled metallic sheets suggest pantropy. A sheet cold-rolled in only one direction seems at first as stiff crosswise as lengthwise. Cold-twisting raises the tensile strength, that is, the strength in a plane 90 degrees from that of the main distortion. Cold-rolling, like wire-drawing, draws the metal out lengthwise; yet in the Lauth cold-rolling procedure at the works of the Jones & Laughlin Steel Co., as investigated by Thurston, it increased the transverse strength by between 50 and 80 per cent, while increasing the tensile strength in a smaller proportion, by between 25 and 40 per cent. It raised the "elastic limit" which was probably the proportionality limit, torsionally, tensilely and transversely, by between 80 and 125 per cent, and the elastic resilience by between 300 and 400 per cent lengthwise and by between 150 and 425 per cent crosswise.

Evidence Misinterpreted

From the fact that overstrain in either direction lowers the proportionality limit in the opposite direction, some have inferred that it is monotropic, in the sense of strengthening in its own direction though weakening in the opposite direction, inferring for instance that a tensilely overstrained piece, if judged by its proportionality limit, is stronger tensilely but weaker compressively than before. So far as I know this has not yet been shown. On the contrary, such evidence as I have found points in the opposite direction. Thus the lowering of the compressive proportionality limit caused by tensile overstrain has been noted immediately after the overstrain. But here is no true suggestion of monotropy, because the tensile proportionality limit also, if determined at that time, has been lowered simultaneously very greatly, if not indeed to zero.



NON-PULSATING PUMP

It is perfectly true that this tensile limbering is only temporary, and that the tensile proportionality limit thus lowered rises slowly during rest in the cold, and very rapidly on heating. This may have given rise to the idea of monotropy, on the assumption that the compressive limbering is permanent. But for this assumption I know of no evidence.

The fact that prior overstrain, as in cold-rolling, commonly raises both elastic limit and tensile strength, but the former more than the latter, can be interpreted as meaning that the elevation of the elastic limit which that prior overstrain causes is partly an anticipation of the elevation which would occur in the tensile test itself, and partly an addition to it.

The investigations underlying this paper were carried out in part under a grant from The Carnegie Institution of Washington. The author wishes to thank his assistant, A. G. Levy, and also Professor James S. Macgregor, and F. Miller, of Columbia University, for the Brinell hardness and density determinations.

Non Pulsating Pump

The interest in the pump shown in the illustration lies in the fact that the pistons are not operated from a crank shaft, as in the ordinary type of reciprocating pump, but by cams. The cams are keyed to the main shaft and each transmits its motion to its piston by means of a sliding yoke, rollers being used to minimize friction between the cam and the yoke.

The manufacturers claim that this construction keeps the load on the piston uniform instead of passing through a cycle running from full load to a complete stop and back again, as in the crank shaft pump. Hence there is said to be no pulsation, less strain on the pump, and high efficiency owing to the absence of backlash when gears and other parts have become worn. In fact, the manufacturers claim an efficiency of 80 per cent for the pump. The Liutweiler Pumping Engine Co., Cleveland, O., is the manufacturer. Westinghouse Electric motors are used for the drive.

The International Oxygen Co., Newark, N. J., has shipped a plant for the manufacture of oxygen to the Australian Oxygen Co., Melbourne, Australia. This machine uses a current of 400 amperes, the pressure on each cell being 2.2 volts. The production of oxygen is about 3.8 cubic feet per kilowatt hour and the production of hydrogen is about 7.6 cubic feet per kilowatt hour. The machine was purchased by W. Russell Grimade, manager of the Australian Oxygen Co.

Judge Thomas, in the federal district court, Hartford, Conn., has issued a permanent order restraining the Electric Mfg. Co., Bridgeport, Conn., from infringing letters patent on safety fuses held by the Johns-Pratt Co., Hartford, through assignment by Joseph Sachs.

Kerr Turbines in Large Sizes

Description of a New Line of Multi-Stage Machines Ranging From 700 to 1800 Horsepower

FOUR or five years ago when European engineers were turning to the multi-stage type of turbine, American engineers in the employ of the Kerr Turbine Co., of Wellsville, N. Y., also decided to build this type of machine. At that time, the seeming disadvantage of the multi-stage turbine, from a commercial standpoint, was high first cost, due to large number of stages necessary—an objection which has since been overcome by efficient shop methods and standardized manufacture.

The standardization of parts has been carried to such an extent by the Kerr Turbine Co. that with the exception of the diaphragms all parts are made in large lots, which after a rigid inspection, are passed into a stock room for future use. Then upon receipt of an order, the diaphragms are made up with vanes specially arranged to meet the steam conditions, while stock bearings, bucket wheels, etc., are assembled for the rest of the machine. Quite naturally this system permits prompt shipment and enables a customer to replace a part at any time on short notice.

Recently the Kerr company has developed a new line of turbines ranging from 700 to 1,800 horsepower in size. Figs. 2, 3 and 4 show the horizontally split shell employed in these larger machines. The rotor may be easily inspected or removed entirely without breaking steam connections. When the turbine cover is removed each entire wheel is exposed down to the carbon packing on the shaft, there being no diaphragms left between the stages, as these are integral with the casing and lift off with it. The guide vanes or steam nozzles are cast in the diaphragms, a practice followed by all foreign builders.

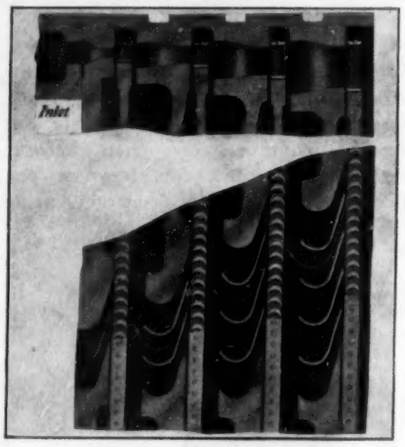


FIG. 1—CROSS SECTION OF VANES AND BUCKETS

Expanding steam from initial to terminal pressure in a number of stages or steps, as in the Kerr turbine, makes the pressure drop at each set of nozzles comparatively small, with correspondingly low steam velocity, the latter rarely being over 1,000 feet per minute. The leakage area from stage to stage is also small, being confined to the annular space walls or diaphragms, rather than around the entire periphery of the buckets.

Leakage from stage to stage at the shaft is prevented by floating carbon packing rings held in the diaphragms and in the high and low pressure ends with cover plates. They are so arranged that they move freely in any direction, in case the turbine shaft should vibrate with a large dose of water. The fact that the steam pressure is higher on one side of the diaphragm than on the other, keeps the carbon rings tight against ground seats.

The large clearance permissible at the buckets is utilized as shown in Fig. 5, to protect the buckets from stripping. The original skin left on the drop-forged buckets resists the tendency of the low steam velocity toward erosion. The buckets are riveted into the wheels as shown in Fig. 6.

The matter of lubrication has been given careful consideration. A small tur-

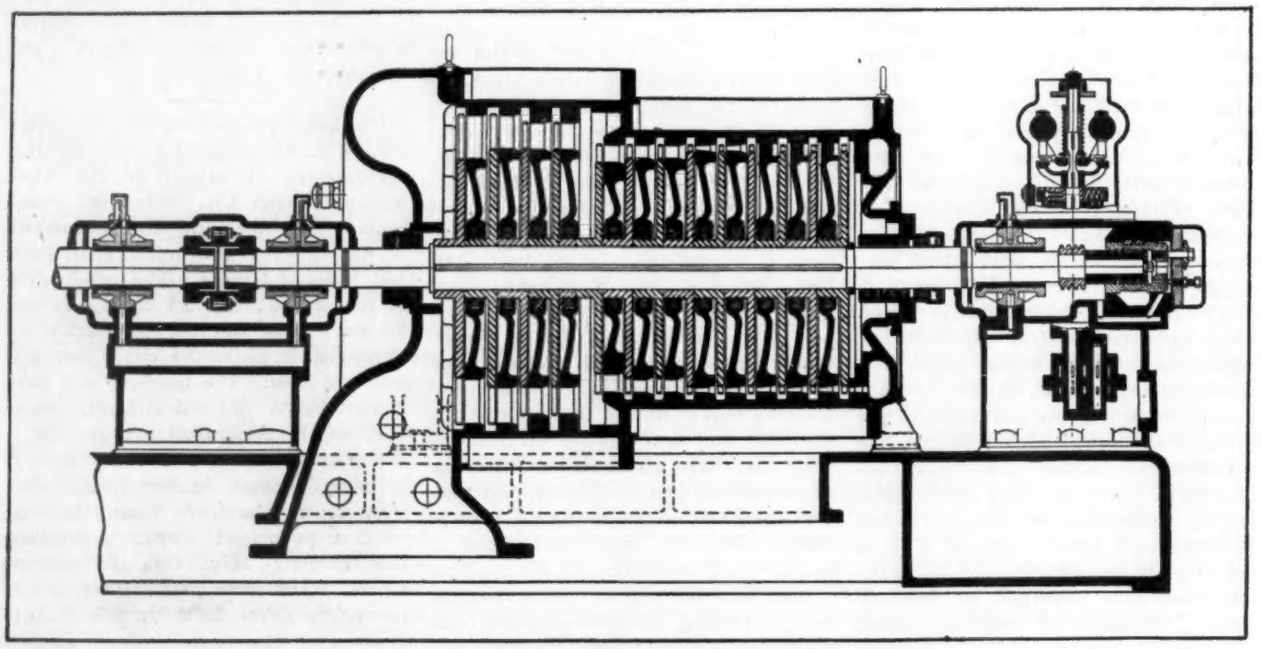


FIG. 2—SECTION THROUGH A LARGE KERR TURBINE

bine-driven centrifugal pump with impeller submerged in the oil reservoir forces oil to all the bearings before the machine is turned over, and after starting, a spur-geared oil pump directly connected to the gov-

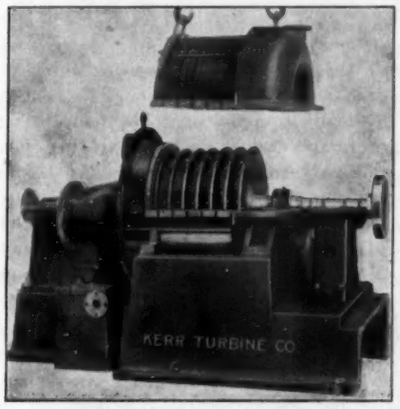


FIG. 3—TURBINE WITH SPLIT CASING REMOVED

ernor spindle forces oil under 6 pounds pressure to every bearing on the unit. The oil drains back by gravity to a large reservoir in the bed-plate, where it is strained and water cooled. Serious over-speeding in the multi-pressure type of turbine is practically impossible and as the wheels in Kerr turbine are designed with a large safety factor, the maximum speed of a run-away unit would probably do no damage. However, the turbine is provided with an independent emergency governor operating a quick-closing throttle valve.

The simplest form of throttling governor, it is said, can be used safely and gives a comparatively flat steam consumption curve for all loads; but the governor generally used on the larger sized units is of the oil relay throttling type, the valve being moved by oil under 30 pounds pressure with the compensating mechanism usually employed by turbine build-

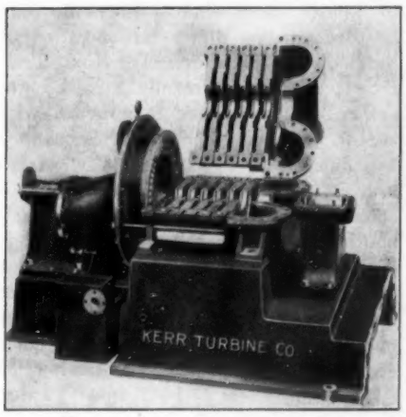


FIG. 4—TURBINE WITH ROTOR REMOVED

ers. The bearings are of the heavy pedestal type, ring oiling. A marine type thrust bearing, which is adjustable and replaceable, maintains the rotor in proper position, although a slight floating would do no harm to the buckets.

The entire unit is mounted on a heavy cast iron bed plate, and the lagging outside the turbine cylinder is covered with enameled sheet iron.

Progress on Crane Plant

Progress on the new plant of The Crane Co., on Kedzie avenue, Chicago, between Thirty-ninth and Forty-third streets, is being made rapidly. The company has bought 160 acres and expects eventually to cover at least 30 acres with buildings. The property has a frontage somewhat more than 2,400 feet and with the

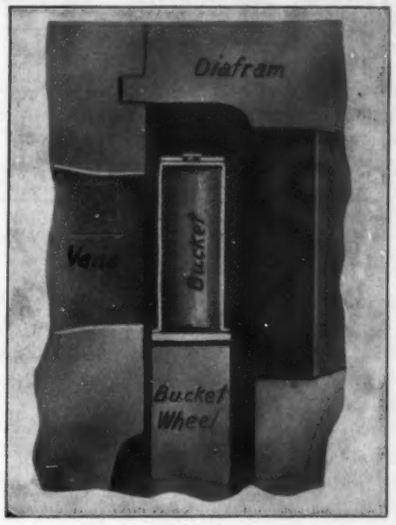


FIG. 5—LARGE WHEEL CLEARANCES

exception of a small space at each end this entire frontage is being built on at present. The buildings are 150 feet back from the street line and at present 2,400 x 240 feet are being put under roof. Eventually the buildings will extend a width of 1,300 feet from the street and the full 2,400 feet in length. They are being constructed in units approximately 80 x 400 feet each.

The buildings under erection at present include a five-story structure, 62 x 150 feet, with a clock tower 175 feet high, building C1 and C2 each two stories, 80 x 400 feet, to be used as brass fitting shops, and D1 and D2, the same size, for the cast iron fitting shops.

The buildings are entirely of steel and reinforced concrete; the exterior walls will have concrete pilasters and brick panels. The panels and windows are arranged to present an artistic exterior appearance and pavilions at intervals will relieve the long lines. All the roofs are to be of red tile. The Crane Co. about 10 years ago moved its works to Twelfth and Canal streets, but a year ago sold its prop-

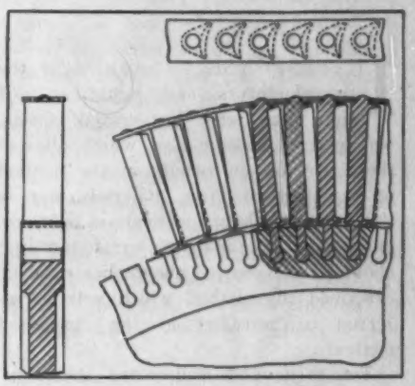


FIG. 6—SHOWING METHOD OF INSERTING BUCKETS

erty at that place to the Chicago, Burlington & Quincy Railroad Co. for $4,000,000. Three years was stipulated during which the company was to vacate the premises. The first year expires July 1, 1914, and sufficient progress has been made to warrant the prophecy the company will not need much more than half the three years to make the change to the new location.

Despite the unsatisfactory market conditions of the present year, the Crane Co. has not laid off any of its working force. The places of men who leave its employ are not filled and from time to time in the course of business some men are laid off for causes other than slack business and these places are not filled. Only in these respects is the force less than during more prosperous times and the company is storing its product in the belief a demand for it will arise before long and it will be ready to fill a rush of orders.

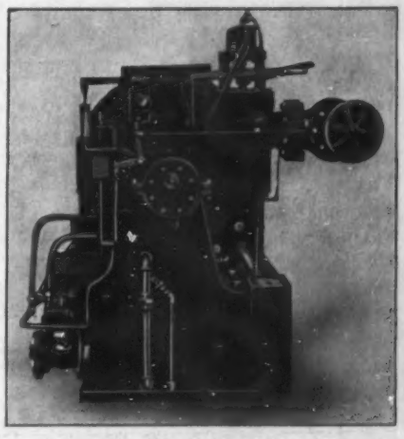


FIG. 7—OILING SYSTEM AND GOVERNOR

Maintaining Tin Plate Standards

How to Take Samples and Analyse Tin, Terne and Lead Coated Sheets

BY J A AUPPERLE

IN RESPONSE to inquiries to the manufacturers and consumers of tin, terne and lead-coated sheets, we received information which showed there was no uniformity in the method of sampling of these materials, nor in the amount taken for analysis. As regards chemical analysis, we found that about 90 per cent of the replies received described the method which will be referred to hereafter as the "proposed method".

Tin, terne and lead-coated sheets invariably contain a ridge of heavy metal at one edge, due to the flow of metal after the sheets are coated. The manufacturer ordinarily bases the weight of coating upon the weight of a box of black sheets, and the weight of the same sheets after coating. The consumer is not interested in the amount of heavy metal on certain portions of the sheet known as "list edge"; that in which he is interested is the average weight of coating. Consequently, when an analysis is made disregarding the "list", a difference of several pounds per box may be found between the amount of metal the manufacturer puts on the sheet and the amount found by chemical analysis.

In order to standardize the methods of sampling, it is desirable to disregard the "list edge", and to take a sample which fairly represents the average of the sheet. From investigations which we have conducted, we believe that samples from near the four edges of the sheet accurately represent the average coating.

Method of Sampling

We therefore propose the following method of sampling and methods of analysis:

Four 2 x 4-inch pieces are cut, one from each end and each side of the sheet, parallel with the sides and equidistant from the ends, as shown in Fig. 1. One sheet from each grade or shipment is taken for analysis.

These samples, before weighing, should be thoroughly cleaned with chloroform, carbon, tetrachloride or gasoline. Each piece is then cut in half, marking one half "A" and the other half "B". The four pieces comprising lot A are then accurately weighed together, cut into small pieces about ⅛ inch square, thoroughly mixed, and used for the determination of tin and lead. The four pieces comprising lot B are reserved for the analysis of base metal and the direct determination of coating as a check on the analysis of lot A.

A templet should be provided, made preferably from steel ⅛ inch thick and

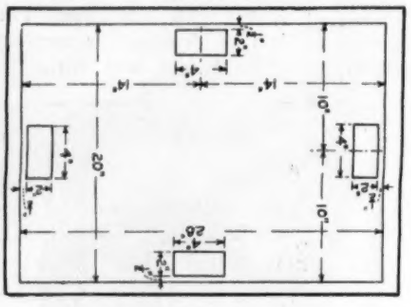


FIG. 1—METHOD OF SAMPLING TIN SHEETS

exactly 2 x 4 inches. A scribe is used to accurately mark the sections to be cut. The templet is then used to subdivide the 2 x 4-inch specimens into two pieces, 2 x 2 inches. The sections for analysis are then cut with tinner's shears.

Three 5-gram portions of the finely cut sample of lot A are placed into three 300-cubic centimeter Erlenmeyer flasks, each fitted with a one-hole rubber stopper containing a glass tube bent twice at right angles, one end of which projects through the rubber stopper for a short distance, the other end being long enough to reach almost to the bottom of a beaker, placed on a level with the flask, containing about 300 cubic centimeters of dilute sodium-bicarbonate solution. Add 75 cubic centimeters of concentrated hydrochloric acid, connect the flask with the stopper containing the glass tube, and place the flask on a hot-plate. Heat gradually at first until most of the metal is in solution. The long end of the glass tube, in the meantime, is submerged in the beaker. The hydrochloric-acid solution is finally brought to boiling and when all the metal is dissolved the beaker containing dilute sodium-bicarbonate solution is replaced by one containing a saturated solution of the same. Remove the beaker and flask to a cool place. This will cause a small amount of the sodium-bicarbonate to enter the flask and exclude the air. The solution is finally brought to a low temperature, preferably with ice water. This solution is then diluted to about 200 cubic centimeters with oxygen-free water which contains several cubic centimeters of starch solution, and titrated with N/20 iodine solution. We have found this strength of iodine solution to be the most satisfactory for this method.

The distilled water free from oxygen is obtained in any of three ways: (1) By passing carbon dioxide through the cold distilled water; (2) by boiling vigorously and cooling; or (3) by adding a few cubic centimeters of concentrated hydrochloric-acid to the water and then about 2 grams of sodium-bicarbonate, stirring vigorously. By running this determination in triplicate, the first titration serves as a control to indicate the number of cubic centimeters of iodine required, whence the two succeeding titrations may be made very rapidly and should check very closely.

Determination of Lead

Dissolve 10 grams of the finely cut sample of lot A in 150 cubic centimeters of nitric acid (1:1). Heat until free from brown fumes and dilute to one liter and mix thoroughly. Take 100 cubic centimeters of this solution, add 10 cubic centimeters of concentrated nitric acid, electrolyze at a temperature of 50 to 60 degrees Cent., using one to two amperes and 2.3 to 2.5 volts. The weight of PbO_2 is multiplied by 0.866.

The remaining four pieces representing lot B are used for the analysis of the base metal and incidentally can be used for the direct determination of the weight of coating. The four 2 x 2-inch pieces are carefully weighed together and each piece is wrapped with a stiff platinum or nickel wire in such a manner that it may be placed in the acid in a horizontal position. Heat 60 cubic centimeters of concentrated sulphuric acid contained in a 400-cubic centimeter Jena glass beaker to at least 250 degrees Cent., immerse each piece separately in the hot acid for exactly one minute, and remove to a 600-cubic centimeter Jena beaker containing 50 cubic centimeters of distilled water. Immerse momentarily and rub the surface while washing with about 50 cubic

A paper presented at the meeting of the American Society for Testing Materials at Atlantic City, June 30 to July 3.

centimeters more of distilled water, using a wash bottle for this purpose. The four samples are thoroughly dried, reweighed, and used for the analysis of base metal.

The loss in weight represents the coating and some iron. The sulphuric acid contained in the 400 cubic centimeter beaker is cooled and combined with the washings in the 600 cubic centimeter beaker. Two hundred cubic centimeters of concentrated hydrochloric acid are added and the solution boiled for a few minutes. The solution is cooled, poured into a graduated 500 cubic centimeter flask and filled to the mark with distilled water.

Place 100 cubic centimeters of this solution in a 300-cubic centimeter Erlenmeyer flask, add one cubic centimeter of a saturated solution of potassium permanganate to oxidize the iron and tin, heat to boiling and reduce with a few drops of stannous chloride. Cool, pour into a liter beaker containing 400 cubic centimeters of distilled water, add 25 cubic centimeters of mercuric chloride, followed by 10 cubic centimeters of phosphoric acid and manganese-sulphate solution, and titrate with N/10 potassium permanganate.

In the analysis of tin plate, the weight of coating is expressed in pounds per box, which is a half case, or 112 sheets 14 x 20 inches; hence to obtain the weight of coating per box on tin plate, the number of pounds as obtained above is divided by two.

The remainder of the solution which has been used for the determination of iron can be used for the determination of tin as follows: Place three portions of 100 cubic centimeters each in three 300-cubic centimeter Erlenmeyer flasks. If any of the lead sulphate should or should not be removed in any of these portions, the accuracy of the tin determination is not affected. Add 1 gram of powdered antimony, connect with rubber stopper and glass tube described in the method of determination of tin in the sample of lot A, place on a hot-plate, using dilute sodium-bicarbonate solution as a trap, and heat until the solution becomes decolorized. Replace the dilute sodium-bicarbonate solution with a saturated solution of the same, remove from the hot-plate, cool, dilute and complete the determination as described under the first method.

Blast Furnace Slag in Concrete

BY W A AIKEN

EVERY NEW or extended utilization of by-products makes for economy in the conservation of resources. The millions of tons of blast-furnace slag annually produced in the United States, for years considered not only practically worthless, but always a nuisance, and entailing unavoidable expense in handling and disposal, have from time to time to some extent been utilized in a variety of ways; one very important use of certain of these slags being in the manufacture of a valuable product, Portland cement. But the percentage of furnace slag made use of this, or indeed in any other way, such as for track ballast or for building macadam roads, is at present relatively very small, and yet is actually considerable in tonnage. Any increase in the use of this product, should the adaptability of slag for concrete aggregate be generally recognized, would furnish a very desirable outlet. To be sure, its adaptability for this purpose has always been recognized by large iron manufacturers, who early made use of this handy material when concrete construction was undertaken around their plants; but it has not been adopted generally.

With the marvelous growth in recent years of concrete construction, and especially reinforced concrete, the advantage of furnace slag as aggregate in reducing the dead weight per cubic foot of concrete, has made a strong appeal to many concrete engineers. The result is that the building codes of several of our large municipalities have permitted the use of furnace slag equally with any other material ordinarily used for aggregate in concrete.

Originally, we made a few comparative tests using different aggregates, such as limestone, Birdsboro trap rock, and slag; the tests being carried on only to the 28-day period. This was done to arrive independently at the relative actual values of these different materials. As a result of these early tests and the showing made therein by slag, we undertook an extended series of tests involving the manufacture of five hundred 6-inch cubes; 100 of these to be crushed at each of the several periods, 28 days, 3 months, 6 months, 9 months and 1 year, so as to arrive at entirely reliable averages, and to establish the uniformity of the character of the concrete. As the work progressed, results were such that the number of cubes tested at the 9-month and 1-year periods was reduced to 50 each, and it is proposed to crush the remaining 100 cubes at 6-month intervals up to 6 years—10 cubes at each period.

The materials used in this investigation were all commercially produced in Philadelphia, and the work of making the specimens was no better than that under ordinary field conditions of concrete construction—no attempt having been made to enter into any elaboration. Thorough mixing, however, was positively assured, the work being done by hand. The molds used were in gangs of tens and made of planed 1-inch white-pine lumber, put together with screws. The cement used was a standard Lehigh Valley brand showing compliance with the standard specifications of the American Society for Testing Materials.

The sand used was Jersey gravel, the material almost universally used in the vicinity of Philadelphia. This showed the following granulometric analysis:

Sieves.	Amount passing, per cent.
¼-in.	97.4
No. 10	90.8
No. 20	73.8
No. 30	63.8
No. 40	55.2
No. 60	35.4
No. 100	11.6

This is not ideal material, as will be recognized, but was used because it is the material of the market.

The coarse aggregates, commercially called ¾-inch material, all passed the 1¼-inch sieve and were retained on the ½-inch sieve.

The slag used showed the following chemical analysis:

	Per cent.
Silica (SiO_2)	34.40
Alumina and iron oxide (R_2O_3)	23.40
Lime (CaO)	35.88
Magnesia (MgO)	3.21
Sulfuric Anhydride (SO_3)	0.39
Sulfur (S)	1.27
Loss on ignition	1.34

All material was measured by volume in the proportions of one part cement, two parts sand and four parts coarse aggregate; this being the requirement of the Philadelphia Building Laws. All concrete was mixed to ordinary work consistency—rather wet than dry.

The preliminary investigation for comparative purposes gave the following average results from three 6-inch cubes at 7 days and three 6-inch cubes at 28 days:

Coarse Aggregate.	Compressive strength, lb. per sq. in. 7 days.	28 days.
Limestone	390	941
Birdsboro Trap Rock	1,144	1,888
Slag	1,681	2,537

There was then undertaken the main investigation covering the manufactur-

Paper presented at annual meeting of American Society for Testing Materials, June 30-July 3.

ing and testing of the 500 slag cubes. These were all air stored in a dry cellar, being sprinkled with water once a week. They gave on breaking the results found in the accompanying table.

A study of this detailed differentiation of test results shows that at 28 days, three months and six months, of the number of individual tests failing to closely agree with the several general averages, the large percentage of these show considerably greater strength than these general averages or than the average of the larger percentage of tests which agree so closely with the several general averages. The average strength noted in all the tests at these periods, 28 days, three months and six months, may therefore be assumed as conservative.

A similar study of results at nine months and one year shows that of the results not in close agreement with each period's general average, or with the larger number of tests at each period which closely approximate these general averages, a somewhat larger percentage falls below this general average than that which runs above. But as those results which are above the general findings average relatively much more *above* such general findings, than the low results average *below* these general findings, it may again be assumed that the average strength results of all tests at the later periods of nine months and one year are equally conservative.

This is more particularly evident when it is borne in mind that the sand used was not what could be considered first-class material and undoubtedly influenced the strength of the concrete developed. Also, the comparatively small size of the slag aggregate must necessarily have influenced the strength of the concrete, while the results would probably have been higher, had the test specimens been larger. It is also to be noted that in so far as the author's observation goes, the results are markedly lower than those published by other investigators of slag concrete.

The main point is whether the compressive-strength values herein developed are sufficiently great to warrant the employment of slag as aggregate, in competition with broken stone and gravel. We think the findings are in favor of this, since our experience has been that the crushing strength of broken stone or gravel concrete, made up under ordinary field conditions, will not average over 1,500 pounds per square inch at the age of 30 days. Consequently, from the actual strength of the concrete developed in these tests; its weight per cubic foot (which is less than that of most materials used similarly); the recognized solubility of slag, which permits it to act as a puzzolanic material; its alkaline nature, which is especially conducive to rust-prevention in the case of re-inforced-concrete construction; and from the relatively high combined percentages of silica, alumina and iron, which make for permanency of the resulting concrete: we conclude that slag of similar constitution is in every way satisfactory for use as aggregate in concrete.

COMPRESSION TESTS ON 6-INCH SLAG-CONCRETE CUBES

Average Weight of the Concrete Being 140.8 Lb. Per Cu. Ft.

Time at which tested.	No. of specimens.	Average compressive strength lb. per sq. in.	Remarks.
28 days	100	1,561	73 per cent of all the tests averaged 1,533 lb. per sq. in.; within 2 per cent of the general average, but lower. 20 per cent of all the tests averaged 1,730 lb. per sq. in.; within 11 per cent of the general average, but higher. 7 per cent of all the tests averaged 1,344 lb. per sq. in.; within 14 per cent of the general average, but lower.
3 months	100	1,952	78 per cent of all the tests averaged 1,922 lb. per sq. in.; within 2 per cent of the general average, but lower. 15 per cent of all the tests averaged 2,185 lb. per sq. in.; within 12 per cent of the general average, but higher. 7 per cent of all the tests averaged 1,794 lb. per sq. in.; within 8 per cent of the general average, but lower.
6 months	100	2,589	73 per cent of all the tests averaged 2,583 lb. per sq. in; practically in complete agreement with the general average. 14 per cent of all the tests averaged 3,058 lb. per sq. in.; within 18 per cent of the general average, but higher. 13 per cent of all the tests averaged 2,125 lb. per sq. in.; within 18 per cent of the general average, but lower.
9 months	50	2,841	72 per cent of all the tests averaged 2,874 lb. per sq. in.; within 1 per cent of the general average, but higher. 8 per cent of all the tests averaged 3,367 lb. per sq. in.; within 18 per cent of the general average, but higher. 20 per cent of all the tests averaged 2,514 lb. per sq. in.; within 12 per cent of the general average, but lower.
1 year	50	2,797	84 per cent of all the tests averaged 2,812 lb. per sq. in.; within 1 per cent of the general average, but higher. 6 per cent of all the tests averaged 3,534 lb. per sq. in.; within 26 per cent of the general average, but higher. 10 per cent of all the tests averaged 2,342 lb. per sq. in.; within 16 per cent of the general average, but lower.

Institute of Metals

Portsmouth, England, has been selected as the place of meeting for the autumn conference of the British Institute of Metals. The conference, which will be presided over by Engineer Vice-Admiral Sir Henry J. Oram, K. C. B., F. R. S., the president of the Institute of Metals, will be held on Thursday, Sept. 10, and Friday, Sept. 11, in the Municipal College, a number of important papers being read each morning. In the afternoon of Sept. 10 a visit will be paid to Portsmouth dockyard, and there will be a dinner in the evening. On Sept. 11 the afternoon function will consist of a luncheon at the Cowes works of J. Samuel White & Co.

The buildings being erected by the Aberthaw Construction Co., Boston, at New Haven, Conn., for the Highwood Co. and the Oven Equipment & Mfg. Co., are making rapid progress. The plans call for a large building 400 feet in length, along the railroad tracks, with several buildings at right angles to this and separated from each other and from the present Oven Equipment building by courts. All the sand needed for the concrete work was dug out of the cellars. A large portion of the work, including all of the form work, is being carried on under a bonus system which is working out to advantage.

The Vaterland, which has just been placed in service on the Atlantic, carried 300 tons of copper metal to Hamburg on its first eastward trip. Although this ship is not a freight steamer the need for the copper was so urgent it was sent on the Vaterland rather than to wait for a slower steamer at a later date.

Fig. 1—Loading a 5-Ton White Truck in the Scully Warehouse at Chicago

Running Your Truck at Least Cost

A GOOD 5-ton motor truck will do the work of three or more heavy two-horse drays, but it must not be forgotten that it costs as much on the average to operate the truck as it does to run two drays. Owners of power vehicles have spent a great deal of vital energy in getting their cars and delivery organizations speeded up to the point where one truck will do the work of eight or more horses, but comparatively little energy in so directing their affairs that the individual truck is operated at minimum expense. It is not difficult to take a given number of motor trucks in ordinary service and by the speeding-up process increase their

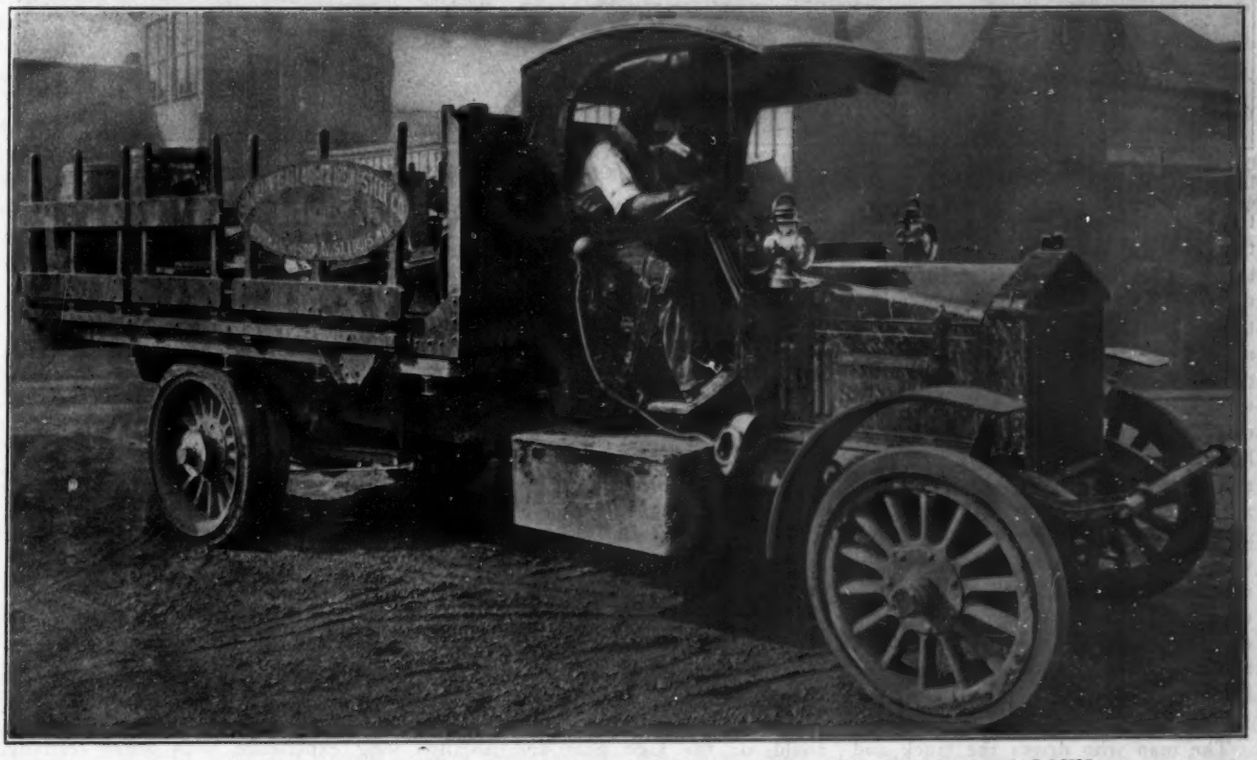


FIG. 2—PIERCE-ARROW TRUCK WITH LOAD AT SCULLIN-GALLAGHER PLANT IN ST. LOUIS

ton-mile performance 50 per cent or more; it is, however, an entirely different problem to increase the tonnage carried and the mileage traveled without increasing the ton-mile expense. It is easy for a new 5-ton truck constantly carrying a full load to cover 40,000 miles in a year, but it is difficult to do this without depreciating the value of the machine 50 per cent or more through excessive wear and tear. Builders of motor trucks often boast, with reason, about the capacity and service possibilities of their vehicles and about the amazing tonnage records they can make compared with horses or other methods of hauling, but the buyer and user of trucks is also interested in efficiency. The shrewd manufacturer knows well enough that his motor truck will triple the work of his best team, but he wants the machine to do this at an annual expense at least not more than double that of operating the team. Otherwise the superior service of the motor vehicle is a delusion. If the owner of a motor truck does not exercise sufficient care to operate it with the utmost economy he had better dispose of it at once and return to horse hauling, because a power vehicle may easily become a very expensive luxury. True motor truck economy is found when a maximum tonnage is hauled at minimum expense, and the problem of keeping down running expenses looms large before every owner of motor vehicles. How may this problem be most effectually solved?

The man who drives the truck and the facilities which the owner has provided for its proper care are the two greatest factors influencing the cost of operation. Of the two, the man is by far the more important consideration. To illustrate: A manufacturer of drill presses owned three 3-ton gasoline-driven motor trucks of identical make and age. These vehicles were operated successively for a month each over the same route doing as nearly as possible an equal amount of work. Each truck had a different driver. The average cost of operating each machine was found to be 31.7 cents, 27.1 cents and 10.0 cents per vehicle-mile, respectively. Obviously there was a vast difference in the three drivers and in their methods of work.

The foregoing incident is by no means unusual. The same differences may be found in the records of any railroad. One engineer will be obliged to stop at every water tank and coaling station on the division; another with the same engine and train will whirl past water tanks and coal bunkers, maintaining the schedule without apparent effort. What causes these differences in man-efficiency? Variations in natural ability, of course, but also to a greater extent differences in the care, thought and effort applied to the work. Investigation showed that of the three motor truck drivers mentioned above, the one with the most expensive record never took the trouble to stop his engine, was so careless about lubrication that he lost time with hot boxes, always stopped with a jerk and started, if he could, on the high gear and usually spilled half a gallon of gasoline every time he would fill the tank. Investigation shows that there are three classes of motor truck drivers and three kinds of knowledge necessary in running a commercial motor vehicle. The first class of drivers are young men without much previous experience but with mechanical tastes who are attracted to the commercial vehicle on account of its novelty and opportunities for adventure. These men would never take up horse trucking as a vocation, but are easily attracted to the motor vehicle. As a class they are fairly desirable from the owner's standpoint, since they bring to their work an enthusiasm which makes amends for their many faults. A driver of this class will often be able to rush a delayed shipment to a dock and catch a steamer about to sail when a more easy-going temperament would give up the job before trying it. These men will generally have excellent tonnage records and will vie with each other to see who can handle the most freight per day or month, but unless offered special inducements, they are inclined to be extravagant and of little assistance in keeping down running expenses. One manager of a concern employing several young drivers offered a bonus of $10 per month to the one having the smallest gasoline consumption per mile and the smallest repair bills, and as a result cut his operating expenses 20 per cent.

Quite the opposite of the young, enthusiastic driver is the old man of long experience with horse teaming, probably an employe of the firm for

FIG. 3—THE INTERSTATE FOUNDRY, CLEVELAND, USES A 3-TON TRUCK

over 20 years, who is brought face to face with the motor truck at the age of 40. His general knowledge as a teamster and his familiarity with the business of his employer may be of great value, but it must be reluctantly admitted that there is little hope for him in the new order of things. His methods are usually set and crystallized and it is rare when he is able to give up the easy-going ways of the old regime. The motor truck demands much more intelligence and concentration from a driver than a team of horses, and the older men will seldom make the extra effort. They are fossilized. Very few old stage drivers became locomotive engineers and few old teamsters will become truck drivers.

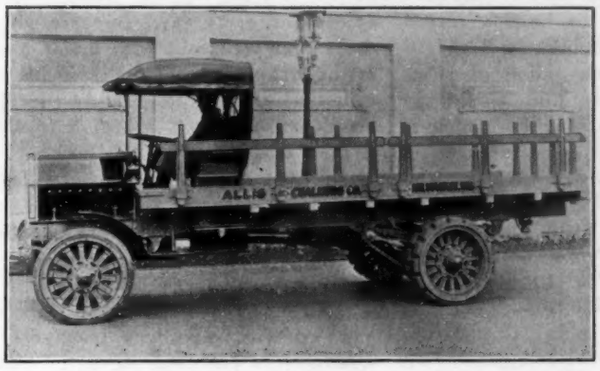


FIG. 4—THREE-TON KISSEL KAR USED BY THE ALLIS CHALMERS MFG. CO.

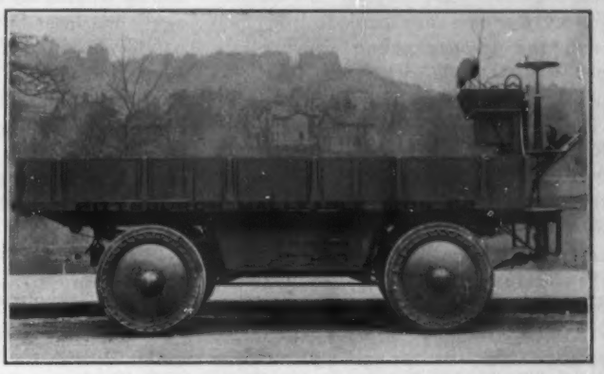


FIG. 5—AN ELECTRIC TRUCK USED BY A MALLEABLE FOUNDRY

The following incident illustrates aptly the difference between the old and new type of men. Two shipments of bolts and spikes were made by a manufacturer to customers each about 20 miles distant. One truck was driven by an old teamster, the other by a fledgling of less than six months' experience but blessed with an active mind. While on the road the same accident happened to each machine, namely breaking the forward connecting rod in the four cylinder engine, but luckily doing little other damage. The old teamster viewed the wreck, sniffed a few times, roundly cursed the motor and then hunted up the nearest telephone and called on the factory for aid. A relay machine was sent out, the disabled one towed home, the shipment transferred and redispatched causing a ten hours' loss of time and a money expense of fifteen dollars. The younger man on the other hand, removed the broken connecting rod, cut a stout stick and skillfully blocked up the useless piston and was on his way again in an hour and a half. A young driver with plenty of enthusiasm is generally to be preferred over the older man even though he be inclined to extravagance. As has been suggested, the younger man can be taught economy and is sure to give better service. Of course there are exceptions, but the average conditions are those which have been pointed out.

The Best Kind of Drivers

The best kind of a driver, however, is one who has had sufficient experience as a teamster to be familiar with traffic conditions, routes, grades and other details regarding roads in his locality and who is also familiar with the peculiarities of his employer's business, but has not become so crystallized but that he will take readily to motor truck service conditions. Such a man, if he can be obtained, is the ideal driver. He possesses in balanced proportions the three kinds of knowledge necessary in his occupation—he has a good working knowledge of his employer's business methods, he knows the roads and traffic conditions in the vicinity where he works, and he has the necessary technical knowledge of motor truck construction to get the most service out of a power vehicle at least cost.

The driver's control over the running expenses of a truck is necessarily paramount and one of the greatest problems of every motor truck owner is to devise methods for getting drivers to work efficiently and to enlist their co-operation in keeping down the cost of operation. Individual circumstances vary widely in this matter, but a few general principles may be laid down. Persuading truck drivers to work efficiently is not greatly different from the general problem of obtaining the greatest return for money invested in labor, and the student of scientific management will readily devise useful plans. It is comparatively easy to establish a bonus or premium system in paying motor truck drivers and this method of inducing efficient operation has met with considerable success. The nature of the business makes it easy for the manager to play on the competitive spirit in the men and so ob-

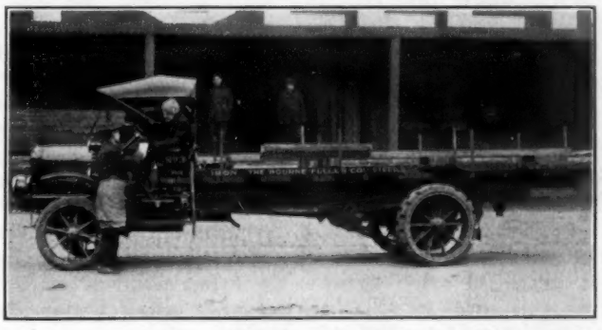


FIG. 6—BOURNE-FULLER CO., USES A HEAVY WHITE TRUCK

FIG. 7—KISSEL KAR IN SERVICE OF UNION DROP FORGE CO.

tain the most satisfactory results. A firm operating eight trucks of similar make and capacity foots up every month the several items of expense and pays a bonus to the drivers making the best record in various lines. Bonuses are paid to the men with the least gasoline consumption per vehicle mile, with the least expense for tire renewals, for general repairs, with the least number of breakdowns in which another truck was called upon for assistance and for the lowest ton mile expense. Splitting up the bonus in this way, permits several men to share in it and keeps up the interest. About the only criticism of this plan is that the bonuses are paid on a basis of comparative performance. It is entirely possible and indeed the case has arisen where the operating expenses of the bonus winners were higher than should be the case with trucks in this particular work. Better results would be obtained if the manager analyzed his costs and fixed standards, paying bonuses only when these standards were maintained or improved upon.

In enlisting the co-operation of your drivers in keeping down running expenses, the necessity of having an exact record of the performance of each machine is very evident. Without reliable records, such as very few firms whose experience has been confined chiefly to horse trucking are inclined to keep, you cannot expect to operate your motor vehicles at their greatest efficiency. Each truck should be provided with an odometer of a type that cannot be tampered with and it should be the duty of the garage superintendent to keep a record of the daily and monthly mileage of every vehicle. Each gallon of gasoline and lubricating oil should be charged to the machine on which it is used. Repairs should be properly charged and the garage expenses and other overhead items should be properly pro-rated between the various vehicles. There should be scales in the shipping room so that the weight of each load taken out may be known, but preferably a platform scale should be provided on which every truck should be weighed on each trip both outgoing and incoming. These records will enable the manager to keep track of his costs with an accuracy which can be attained in no other way and will supply him with the knowledge that is necessary in compelling efficient service from his men.

The record of scale weights showing the load carried by each machine on every trip is particularly important. It costs practically as much to run a truck half loaded as with a full load, and it is very essential that the machines be operated at as near their capacity as possible in order to realize the greatest economy. It is almost equally important to avoid overloading. There is only one sure way for the manager to keep track of this matter and that is to have a record of the loading of his trucks placed before him every day. In cases where the trucks went out with under loads or over loads of more than 10 per cent an explanation should be demanded.

The second important factor in economical truck operation is the garage. Some truck owners have no garages, and others fit out a plant elaborate enough to manufacture vehicles instead of merely to keep them in repair. A little study of railroad methods will help many managers in solving this problem, since the function of a garage is identical with that of a roundhouse. Railroad experience has shown that the locomotive repair bill is lowest when the roundhouse is used only for cleaning purposes and for making routine repairs of a minor nature. Heavy repairs and the periodic general overhauling is done in a shop specially designed for this purpose. Truck owners who follow this system will have the least trouble with their garage management, and unless a firm owns an unusually large number of trucks, it will not pay to fit out a machine shop to do heavy repairing. The overhead expense thus created is generally prohibitive.

How to Test Metallic Coatings

BY J A CAPP

THERE ARE several processes commercially used for covering the surfaces of metals easily corroded or rusted, such as iron in its several forms, with other metals less easily corroded, or with metallic oxides. These may be called "metallic" protective coatings in distinction from the types of coating which are in the nature of paints or their equivalent.

The object of the application of these metallic protective coatings is to enable the coated articles to resist atmospheric exposure without rusting for a longer time than they could withstand such exposure without protection. Obviously, the only final test of the efficiency of a given type of coating is actual exposure to the same sort of influences that the material is supposed to resist in service. If the coating is at all efficient, this takes so long a time that more rapid methods of determining relative efficiencies become a necessity. The most commonly used methods of testing such metallic protective coatings are those of chemical attack, which in effect measure either the thickness or the weight per square unit of the protective coating.

Such methods of chemical attack permit the comparison of results obtained from tests upon the same sort of coating, but difficulty is encountered when attempt is made to compare the results obtained by such tests on one sort of coating with those obtained on another character of coating. For instance, the well-known Preece test yields excellent comparative results on galvanized coatings. When, however, it is used for coatings applied by the sherardizing process, the results are not at all comparable. Neither is the Preece test applicable to coatings of tin or of lead. In the case of sherardized articles, it has been suggested that the coat, which is a combined structure of zinc and zinc oxide, together with some zinc-iron alloy, be removed in strong alkalies which will not attack the iron beneath. This would enable one to determine the weight of coating per unit of surface calculated to metallic zinc, but experience has shown that the results do not necessarily indicate the efficiency of the coat, and that it is not easy to determine the relative proportions of zinc and zinc oxide. Furthermore comparison of the efficiency of a sherardized coating with ordinary galvanizing is not possible when the sherardized coating is tested by solution in a caustic alkali, while the galvanized coating is subjected to the Preece test.

Some years ago, when testing electrical insulation such as is used for overhead line construction, we found that material which stood fairly well when immersed in water failed badly when exposed to the weather, especially if exposed during a hard rain. This

(*Continued on page* 48*b*).

Presented at the Atlantic City meeting of the American Society for Testing Materials, June 30-July 3.

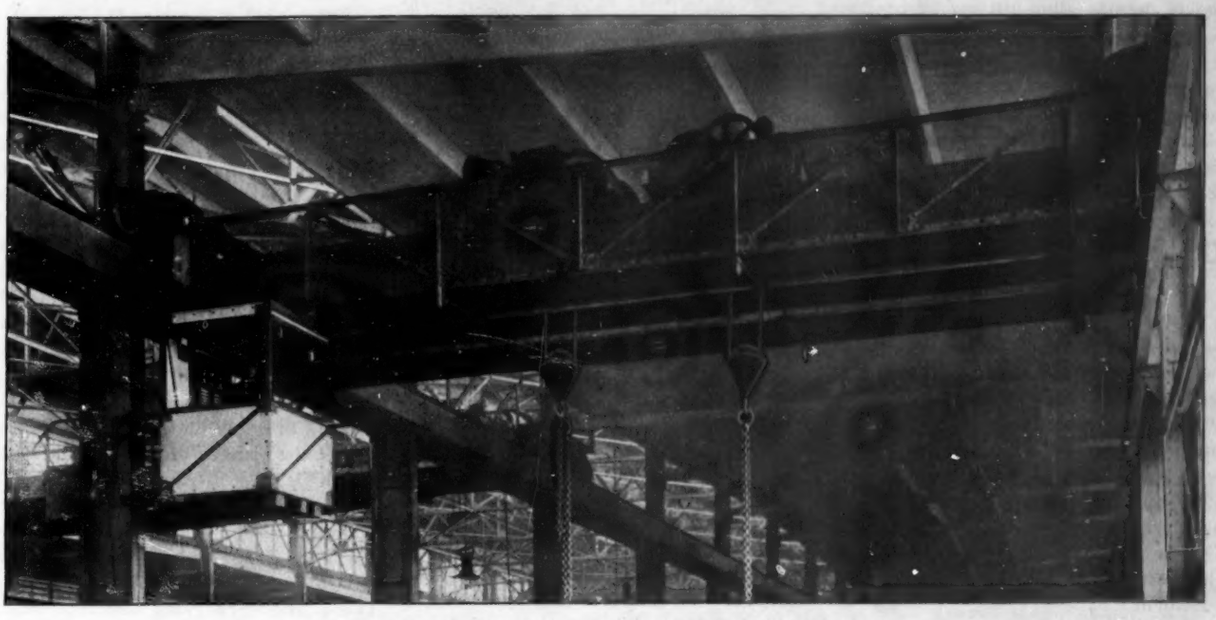
Making Traveling Cranes Safer

How the Illinois Steel Co. is Making Over Old Equipment at the North Works Warehouse so Accidents Will be Avoided

BY GEORGE H MANLOVE

ELEVEN traveling cranes at the North Works warehouse of the Illinois Steel Co., Chicago, are being equipped as nearly as possible to conform to the safety specifications of the United States Steel Corporation. The construction of the old cranes was such as to make it impossible to follow in absolute detail the safety specifications laid down for new cranes. The older cranes in many instances are built of girders deeper at the center than at the ends, while the present type has girders of equal depth from end to end. The position of the motors also has been changed, and in the older types they offer a problem in equipping with safety devices.

Speaking broadly, the additions consist of a walk along the outside of each girder, a bridge over each end of the crane from one side to the other, an absolutely fire-proof cab and a safety switch on top of the crane to prevent its operation by another person while the operator is engaged with the machinery. The walk along the outside of each girder is supported on brackets securely fastened to the girder and is 30 inches wide from the edge of the girder to the outside edge of the walk. The floor is a checkered steel plate, ¼ inch in thickness. Opposite the bridge motor, the width of the walk is reduced to a minimum of 15 inches in the clear. A 4 x 6-inch steel angle bolted to the outside edge of the walk forms a toe-board. Its purpose is to prevent tools or other heavy objects knocked off the floor and possibly striking a person below. A railing 42 inches high is provided on the outside of the walk, and the space between it and the toe-board is filled with 1-inch mesh wire netting. The railing is sufficiently high to prevent a workman from falling over in case he loses his balance in stepping back from the girder. At each end of the crane, steps and a bridge are provided, permitting the operator to cross from one side to the other; this bridge is somewhat narrower than the walks it connects.



TRAVELING CRANE EQUIPPED WITH SAFETY DEVICES

At the beginning of the safety first movement, before the system had been worked out carefully, it was the practice to use a plank walk with a more or less insecure rope running from end to end, which, while an improvement over a bare girder, offered many opportunities for falls.

Can Cut Off Power

An additional safety device of much importance consists of an electric cut-out switch located on top of the cranes at the point where the operator climbs from the cab to the sidewalk. It is his duty to open this switch whenever he goes on top of the crane, thus rendering it impossible for anyone entering the cab to move the crane until the switch has been closed. Accidents have been known to happen to the operator while he was working on the machinery out of sight of observers from below, when the crane was moved by another operator.

All the cabs on the cranes now are made entirely of steel and fireproof materials. Even a small plank formerly used as a base for the electric heater has been done away with, and an asbestos base substituted. The frame of the cab is steel angles; the floor is a checkered steel plate covered with a rubber mat; the sides, top and back are steel sheets covered with asbestos board.

Formerly considerable wood entered into the construction of the cab, which involved danger from fires that started by flashes from the operating mechanism. It is not recalled that any lives have been lost from this cause, but operators have been burned severely. Should a fire occur, the operator has no alternative but to remain in the cab until he can run the crane to a position from which he can descend by a ladder or jump to the floor below, possibly alighting on a more or less ragged footing.

On the entering side of the cab, a platform is provided, with a railing on three sides and a self-closing gate. This prevents the operator from stepping out

of the cab and off the platform in case of carelessness. Whenever the cab is located on the same end of the crane with the electric feed rails, the protection on one side of the platform is carried up several feet and provided with a close wire net. This prevents the operator from getting his hand in contact with the rails, thus receiving a severe electric shock. The steel ladder by which the workmen reach the walks is built against the side of the cab, and at its top is placed the safety cut-out switch already referred to.

Smaller Crane Problems

In equipping the smaller cranes at North Works a different procedure was necessary and the railing along the outside edge was replaced by a bridge work panel which carries the entire load of the walk, the girders not being sufficiently deep to allow the use of brackets bolted to their under surfaces.

The additional weight involved amounts to about 3,000 pounds on the larger cranes, but this is not considered sufficient to interfere with the lifting capacity and the gain in safety far outweighs any other consideration.

Organizes New Bronze Department

The Titanium Alloy Mfg. Co., Niagara Falls, N. Y., announces that it has organized a bronze department for the manufacture of titanium-bronze specialties under its various patents. Wm. M. Corse, formerly works manager of the Lumen Bearing Co., Buffalo, and lately general manager of the Empire Smelting Co., Depew, N. Y., will be associated with the company as manager of this department.

Furnace Plant Sold.—The Nittany Iron Co.'s property at Bellefonte, Pa., was put up at assignee's sale, Saturday, and most of it was disposed of. The furnace plant, 265 acres, and iron ore rights, went to F. L. Crosley, of New York City, for $23,000. He is believed to represent the bondholders. One bid of $7,000 was made for the Nittany Valley railroad, 6 miles long, but even this bid was rejected. The Nittany blast furnace has not been operated for several years.

The contract for the Silver street bridge at Sharon, Pa., has been awarded the C. M. Neeld Construction Co., Pittsburgh, at a bid of $13,504.

The Westinghouse Electric & Mfg. Co., East Pittsburgh, has been awarded a large contract for lighting in one of the residential districts, Chicago.

Motor Drive For Steel Mills

At the annual meeting of the American Institute of Electrical Engineers held in Detroit, June 22 to 26, two papers of considerable interest to the iron and steel industry were presented. The first one, by R. H. McLain, discusses the application of direct current motors to coal and ore bridges. Mr. McLain recommends the use of a series-wound motors for driving the trolley of the bridge and discusses the proper method of gearing the motor in order to obtain economical results. A series-wound motor is also recommended for the low speed hoist and a shunt-wound motor for the speed hoist.

The second paper, by William Oschmann, discusses the use of concatenated induction motors for rolling mill drive. It deals particularly with a six-speed concatenated motor set for driving the finishing rolls of a 12-stand continuous mill. Analysis of the conditions in this mill showed that the use of a low-pressure turbine would lead to the waste of a large amount of exhaust steam and that the alternating-current turbine plant which was in operation had ample reserve capacity for driving the mill. The large number of speeds required suggested the use of a direct-current motor, but as this required a motor-generator set it was found to be more expensive than the concatenated motor. An induction motor operating with a speed regulating set was also considered but its disadvantages lay in the fact that a commutating motor or synchronous converter would be required, the performance of which at the frequency employed being questionable. The concatenated set installed consists of a double-wound main motor and single-wound secondary motor, both stators mounted on a common bed-plate and both rotors on a common shaft. The larger motor has both a 14 and 16-pole stator winding and the secondary motor has its winding arranged for four and eight-pole connections. The control system is described in detail; its operation is very simple, so that no regular attendant is needed. The motor has six definite speeds and two additional resistance speeds, and while the control is somewhat complicated it has been made so nearly fool-proof as to make a special attendant unnecessary. As a result of the year's operation there have been but three interruptions, the total loss of time due to which has been 68 minutes.

R. Tschentscher, electrical engineer, Illinois Steel Co., Chicago, chairman of the Industrial Power Committee of the American Institute of Electrical Engineers, presided when the two papers mentioned above were read and discussed. He said that the applications of electricity in the steel industry have grown to such an extent that he believed it would be desirable for the American Institute of Electrical Engineers to appoint a special technical committee to consider the subject in all its phases. Mr. Tynes, in discussing Mr. Oschmann's paper, said that when any new method of steel mill drive is proposed to the manager of a steel plant, he usually asks: "How much does a spare unit cost?" The evidence presented in the paper indicates that the reliability of the concatenated motor set is equal to that of a steam engine.

Would Force Sale of Property

New York, June 29.—Suit to force the sale of property of the Hudson Iron Co., which owns the Hudson mine at Highland, N. Y., and other mining property at Woodbury, N. Y., and Secaucus, N. J., has been brought in the federal district court here by the Columbia-Knickerbocker Trust Co. The Hudson company has defaulted in the payment of $19,525 interest due on its bonds on Feb. 1 last and also has failed to make sinking fund payments amounting to $10,000. The Columbia-Knickerbocker Trust Co. is the trustee under the mortgage, which is dated March 5, 1906, and against which $802,000 bonds are outstanding. The Trust company took possession of the property on June 20 through Oswald G. Villard, its agent, and is carrying on the business, but it has found that the receipts are not sufficient to meet the obligations under the mortgage. The Hudson Iron Co. was incorporated in 1904 with a capital stock of $1,500,000. Mr. Villard is its president.

Mortgage Foreclosed. — The Cambridge Trust Co., trustee, has foreclosed the mortgage for $100,000, which is held against the Delaware River Iron Shipbuilding & Engine Works, Chester, Pa., and a hearing has been set for Monday, July 13, when the company, which is better known as the Roach Shipyard, will have an opportunity to show why the property should not be sold to settle the mortgage. The mortgagors of the indenture are the Delaware River Iron Shipbuilding & Engine Works; Wm. I. Schaffer, receiver for the mortgagors, and Wm. Holman, realty owner, of New York.

Some Interesting Tests of Oil

If Properly Filtered Oil Apparently Can Be Used Indefinitely And Retain Its Efficiency*

EVEN today, one frequently hears engineers speak of oil "wearing out" some even going so far as to maintain that after oil has been in use for a certain length of time, it should be discarded and replaced by new oil. In order to determine exactly what deterioration oil suffered when in constant use, The Richardson-Phenix Co., Milwaukee, recently had a rather elaborate series of tests made on different samples of oil at the laboratories of Cornell university.

These tests tend to prove that if oil is properly filtered, it can be used over and over again indefinitely without losing any of its lubricating qualities. To show the value of the information obtained in these investigations, the data secured from the Hotel McAlpine tests have been selected as representing the most severe operating conditions.

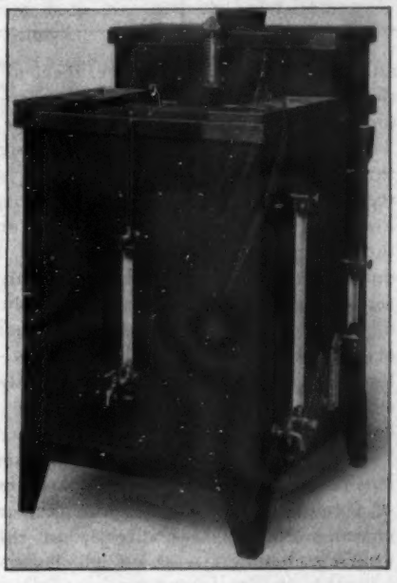
The power plant of the Hotel McAlpine, New York City, is equipped with a Richardson central oiling and filtering system, supplying flooded lubrication to four Wetherill engines having 48 points of lubrication, two Clayton air compressors having six points of lubrication, two Laidlaw-Dunn-Gordon compressors having 16 points of lubrication and one Wetherill crank-and-fly wheel pump having 32 points of lubrication, making a grand total of 134 points of lubrication supplied by the system.

Severe Conditions

This plant operates 20 hours per day, 365 days per year, and the average temperature in the engine room is 100 degrees Fahr. On account of the great variety of machine lubricated, the high load factor and the exceptional temperature conditions, the work imposed on this lubricating system is probably as severe as can be found in any power plant. The oil is a good grade of mineral oil.

To find out how much oil was circulated through the oiling system, ten tests were made at the power plant and it was found that the average amount of oil handled by the lubricating system was 150 gallons per hour, or 3,600 gallons of oil per day. This is an equivalent of 1,800 barrels per month. It is interesting to note that, although this enormous amount of oil is supplied continuously to the bearings, it is only necessary for this plant to add to the system three barrels of oil per month, but even these three barrels cannot be charged to natural shrinkage in the system, for it is drawn off from the filters and used in cans for hand-oiling of small pumps, valve-gears and other bearings not connected to the oiling system.

To determine the changes undergone by the oil, a sample of the new oil as received in barrels from the manufacturers was secured and also a sample of the oil drawn off from the clean oil compartment of the filter. These samples were sealed in the engine room and shipped to the testing department at Cornell university, where without any further purification or filteration, a series of tests were made under the supervision of Professors Carpenter and Sawdon. The results of these tests are given in Tables I and II.



RICHARDSON OIL FILTER

A series of friction tests were made on a Thurston Railroad Lubricant Tester, having a hardened steel journal and bronze bearings with a total area of 20 square inches. In all tests, the testing machine was run at a constant speed of about 360 revolutions per minute and the load applied in increments of 1,500 pounds total pressure, or 75 pounds per square inch. The test at each load was continued until the friction and temperature of the bearings had become constant. The oil was fed upon the side of the bearing through a sight feed oiler and the feed maintained as nearly constant as possible throughout all the tests. Readings were made at ten minute intervals and a large amount of data secured.

The coefficient of friction in the accompanying tables represents the lowest value found for each load, that is as soon as a given load is applied, the coefficient is of course high at first, gradually falling off until it becomes practically constant. This latter figure is the one shown in the tables and represents the value that would obtain in ordinary practice where engines operate continuously for more than an hour. The temperature readings given in the tables are the highest temperature reached for each load, that is, as each new load is applied, the bearing gradually heats up until the temperature becomes practically constant.

As mentioned above, about three barrels of new oil are added to this system per month. However, the system as a whole has been in operation for over a year and a half and the question naturally arises, what physical changes, if any, has the oil undergone during this extended period? The results of tests made to determine this are given in Tables III and IV.

Oil Gains in Specific Gravity

The latter table shows that the oil has gained in specific gravity through constant use. This is what one would naturally expect inasmuch as the oil, in passing through the bearings has had some of its more volatile constituents driven off, also a small quantity of cylinder oil used for lubricating the piston rods and stuffing boxes naturally finds its way into the oiling system. The viscosity curves also confirm this hypothesis, as the tests show that the used oil has a higher viscosity than the new, clearly demonstrating that as oil is used over and over again in an oiling system it actually gains in body provided, of course, the filter thoroughly removes entrained water and this is the vital point of the whole system.

The results of the friction tests as shown are also consistent with these physical changes. It will be noted

that the new oil has a slightly lower coefficient of friction on low bearing pressures while the purified oil shows a lower coefficient on higher bearing pressures. This is due to the fact just noted. In other words, the old oil, having more body, is better able to maintain a lubricating film when subjected to higher pressures. Of course the difference between these two curves is so slight that one can say that for all practical purposes, properly filtered oil is as good a lubricant as new oil under all operating conditions.

Of course, it is needless to remark that in order to secure such results, an efficient filter is necessary and the proposition of thus purifying oil on a commercial basis is naturally of considerable engineering interest. This plant is equipped with two new type Richardson power plant oil filters operating in parallel, each handling an average of 75 gallons of oil per hour. In the design of these filters, special attention has been given to providing a scientific method of precipitation.

If the oil is heated to a temperature of about 150 degrees, its viscosity is only slightly higher than that of water even after the oil has been in service a long time. Now, if oil at this temperature could be spread out in a very thin film, entrained water and other impurities which are heavier than oil would settle out very rapidly. Of course, it is impossible to spread the oil out very thin in a commercial filter handling large quantities of oil, as the size of the filter would be prohibitive. However, this principle has been utilized in the Richardson filter. The dirty oil is first heated as it passes into the filter, after which it is carried to the bottom of a precipitation compartment, where by a novel arrangement, it is spread out to an area of about 14 square feet, although the compartment only occupies 2½ square feet of floor space. The velocity of the oil in passing through this precipitation process is reduced to 0.2067 foot per second. This low velocity allows plenty of time for the precipitation process to be carried out. The importance of thoroughly separating entrained water from the oil is demonstrated by the fact that at the Hotel McAlpine about 4 gallons of water per day is automatically separated and ejected from the precipitation chambers of the filters.

The oil after being separated from entrained water and heavy particles of foreign matter in the precipitation chamber then passes directly to the filtering chambers, each of which contains 12 filtering units having a total filtering area of 3½ square feet. On this basis the filters are handling 2.4 gallons of oil per square foot of filtering surface per hour.

Table I.

SAMPLE OF NEW OIL

Press. on bearing, total lbs....	1,500	3,000	4,500	6,000	7,500
Press. on bearing, lbs. sq. in..	75	150	225	300	375
Duration of test, mins.....	120	50	60	60	50
Temperature of bearing, max..	114.5	120.0	129.5	139.0	143.5
Temperature of room, aver....	68.2	70.7	71.5	72.5	73.0
Diff. in temp. bearing and room	46.3	49.3	58.0	66.5	70.5
Rate feed, drops per min. aver.	34.8	38.4	33.6	37.0	38.2
Speed, R. P. M.....	362	361	361	361	359
Speed, ft. per min.....	355	354	354	353	352
Minimum coeff. of friction....	.01166	.00666	.00533	.00458	.00373

Table II.

SAMPLE OF OLD OIL PURIFIED

Press. on bearing, total lbs....	1,500	3,000	4,500	6,000	7,500
Press. on bearing, lbs. sq. in..	75	150	225	300	375
Duration of test, mins.....	150	60	60	80	50
Temperature of bearing, max..	120	125.5	132.5	144.5	147.2
Temperature of room, aver....	74	74.8	75.3	77.0	77.5
Diff. in temp. bearing & room	46	50.7	57.2	67.5	69.7
Rate feed, drops per min. aver.	38.9	40.3	37.4	40.5	41.4
Speed, R. P. M.....	363	363	360	361	358
Speed, ft. per min.....	356	356	353	354	351
Minimum coeff. of friction....	.01265	.00717	.00522	.00458	.00367

The State Water Supply of New Jersey has granted the application of Witherbee, Sherman & Co. to draw a supply of fresh water from Woodbridge creek and the south branch of the Rahway river, for their proposed blast furnace plant at Sewaren, N. J. The permission was granted, subject to the agreement of the iron ore company to maintain the low flow of stream in the dry season. The Vulcan Detinning Co. had objected to the granting of the application, claiming that the diverting of a large supply of fresh water from the streams would increase the salinity of the latter and would interfere with the manufacturing processes of the company's plant at Sewaren. The Witherbee-Sherman company proposes to build a dam across Woodbridge creek.

Obituaries

Henry P. Ralston, pioneer in the iron and steel business in San Francisco and founder of the Ralston Iron Works, Twentieth and Indiana streets, San Francisco, died at his home in San Anselmo, Cal., recently, at the age of 71 years. Mr. Ralston was born at Greenock, Scotland, Nov. 22, 1842, and came to California in 1866 by way of Australia. He was employed several years in the old Gallagher Iron Foundry, and in 1878 took over a small foundry on Beale street near Howard, which grew into the Ralston Iron Works, incorporated in 1900. In 1904 Mr. Ralston retired from the presidency to the vice presidency and was succeeded by his son, Harry J. Ralston.

George D. Whitcomb, president of the Whitcomb Mining Machinery Co., Rochelle, Ill., is dead at Glendora, Cal., aged 80 years.

Table III.

PHYSICAL PROPERTIES OF NEW OIL

Color:—Medium red, translucent.
Flash point: 410 degrees (open cup).
Burning point: 460 degrees Fahr. (open cup).
Specific gravity at 60 degrees Fahr., 0.895.
Viscosity (with Olsen viscosimeter).
Water as 1 at 60 degrees, Time 27.9 secs. for 100 cc.

Temperature, Fahr.	Time 100cc secs.	Relative Viscosity.
70.0	97.0	3.48
70.0	96.6	3.46
71.0	96.2	3.45
97.0	59.8	2.14
94.0	61.8	2.21
130.0	45.6	1.63
132.0	43.8	1.57
214.0	34.0	1.22
215.0	34.2	1.225

Table IV.

PHYSICAL PROPERTIES OF PURIFIED OIL

Color:—Very dark red, opaque.
Flash point:—410 degrees Fahr. (open cup).
Burning point:—440 degrees Fahr. (open cup).
Specific Gravity at 60 degrees Fahr., 0.903.
Viscosity (with Olsen viscosimeter).
Water as 1 at 60 degrees, time 27.9 secs. for 100 cc.

Temperature, Fahr.	Time 100cc secs.	Relative Viscosity.
68.0	138.0	4.94
69.0	134.0	4.80
70.0	130.2	4.66
103.0	60.4	2.16
114.0	50.6	1.81
130.0	45.2	1.62
152.0	39.0	1.40
147.5	40.2	1.44
218.0	33.2	1.19

Program for Foundry Convention

Outline of Sessions and Entertainment Features of American Foundrymen's Association and American Institute of Metals

PREPARATIONS are rapidly being completed for the celebration of "Founders' Week" at Chicago, from Sept. 5 to 11. Simultaneous annual meetings of the American Foundrymen's Association, American Institute of Metals and the Associated Foundry Foremen will be held, beginning Monday, Sept. 7, while the great display of foundry equipment and supplies will be opened for the inspection of visiting foundrymen on Saturday, Sept. 5.

Both the American Foundrymen's Association and the American Institute of Metals have outlined programs of practical and technical value and a large number of papers and addresses have been promised, which treat of every conceivable phase of foundry work. The tentative program issued by the American Foundrymen's Association provides for the grouping of papers and addresses on similar subjects, to enable the visiting members to attend any session or sessions in which they are directly interested. At the opening meeting, on Tuesday morning, following the formal addresses, the subject that will be considered will be "Safety in Foundry Operation" and in the afternoon papers on "Foundry Construction and Equipment" will be presented. Wednesday morning a joint meeting will be held with the American Institute of Metals, and this session will be known as a "Cost Congress," at which every problem affecting the cost of foundry operations will be considered. Not only cost systems will be discussed, but the methods in vogue in the most important jobbing shops throughout the country for making estimates on new work also will be presented for consideration. This subject is of the utmost importance to every foundryman, and the report on "Estimating the Selling Price of Castings" will prove of great interest to every casting manufacturer. Several papers and addresses on "Efficiency Work in Foundry Operations" also will be presented.

The entire Wednesday afternoon meeting will be devoted to a consideration of "Malleable Foundry Practice" and the subject will be discussed from both the practical and technical viewpoints. "Steel Foundry Work" will be considered on Thursday morning, and Senior Vice President R. A. Bull, who is preparing the program for this session, promises a large number of papers treating of various phases of foundry practice. The last professional session will be held on Thursday afternoon and will be devoted entirely to the consideration of "Gray Iron Foundry Practice".

The American Institute of Metals also has issued an advance program, which promises an unusually interesting meeting. Tuesday and Wednesday mornings joint sessions will be held with the American Foundrymen's Association, but separate meetings will be conducted Tuesday afternoon, Thursday morning and afternoon, and Friday morning. The Associated Foundry Foremen also contemplate holding several meetings for the consideration of papers on practical foundry work.

An elaborate entertainment program has been outlined, which includes a banquet for the members of the Associated Foundry Foremen at the LaSalle hotel on Monday night, luncheon for the ladies at the Stockyards Inn., Wednesday noon, inspection of the stockyards Wednesday afternoon, trip to the White City Wednesday evening and separate banquets for the members of the American Foundrymen's Association and the ladies at the LaSalle hotel, Thursday evening.

That the exhibition of foundry equipment and supplies, and machine tools, to be conducted under the auspices of the Foundry and Machine Exhibition Co., at the International Amphitheater, will be on equally as extensive a scale as last year, is indicated by the large number of space reservations already made. Several manufacturers have increased their space allotment over that occupied last year, and the number of exhibitors promises to exceed last year's total.

Details are going forward for the organization of the American branch of the Becker Steel Co., the third largest steel concern in Germany, at the old plant of the Baldwin Steel Co., South Charleston, W. Va., recently purchased through Charles Capito, president of the Kanawha Banking & Trust Co., and Attorney Richard Price. It will be incorporated probably at $1,000,000, and is expected to be in operation by August 1. The plant will turn out rifle barrels, light armor plate, ball-bearing tubes and high grade steel wire. Equipment and material worth $200,000 is on its way from Germany.

Tentative Program A. I. M.

Monday, Sept. 7.
Registration, LaSalle hotel.
Tuesday, Sept. 8, 10 a. m.
Joint meeting with A. F. A.
Tuesday, 2 p. m.
Professional session.
Wednesday, Sept. 9, 10 a. m.
"Cost Congress," joint session with A. F. A.
Wednesday Noon.
Ladies' luncheon at the Stockyards Inn.
Wednesday Evening.
Trip to the White City.
Thursday, Sept. 10, 10 a. m.
Professional session.
Thursday, 2 p. m.
Professional session.
Friday, Sept. 11, 10 a. m.
Final business session.

Tentative Program A. F. A.

Monday, Sept. 7.
Registration at the LaSalle hotel.
Tuesday, Sept. 8, 10 a. m.
Joint meeting with the American Institute of Metals and Associated Foundry Foremen at the LaSalle hotel. Formal addresses to be followed by a number of papers on "Safety Work in Foundry Operations."
Tuesday, 2 p. m.
Individual session of the American Foundrymen's Association at the LaSalle hotel. Papers will be presented on "Foundry Construction and Equipment."
Wednesday, Sept. 9, 10 a. m.
Joint meeting with the American Institute of Metals at the Saddle and Sirloin Club, adjacent to the International Amphitheater where the Foundry and Machine Exhibition Co. will conduct its big exhibition of foundry equipment and supplies.
This session has been termed a "Cost Congress". Papers will be read and addresses delivered on the necessity of obtaining accurate costs in foundry operations. How to make bids for work will be discussed and a report on this all-important subject will be submitted. The cost committee of the American Foundrymen's Association will present its annual report, suggesting a revision of the Standard Foundry Cost System and a number of papers will be read on "Efficiency in Foundry Operations".
Wednesday Noon.
Ladies' Luncheon at the Stockyards Inn.
Wednesday, 2 p. m.
Entire session devoted exclusively to the discussion of "Malleable Foundry Practice."
Wednesday Afternoon.
Stockyards inspection.
Wednesday Evening.
Visit to the White City.
Thursday, Sept. 10, 10 a. m.
This session will be devoted to "Steel Foundry Practice", the program being prepared by R. A. Bull, senior vice president of the American Foundrymen's Association.
Thursday, 2 p. m.
This session will be devoted exclusively to the presentation of papers and the discussion of "Gray Iron Foundry Practice."
Thursday Evening.
Banquet at the LaSalle hotel, for members only. Speaking will be limited to one or two addresses by speakers of national fame.
Banquet for the ladies at the LaSalle hotel.

Hard Facts Are Blamed

For Poor Showing of Cast Iron Pipe Company, Which Passes Dividend

At the annual meeting of the United States Cast Iron Pipe & Foundry Co., held at the offices of the company at 71 Broadway, New York, June 24, it was decided to pass the dividend on the preferred stock which usually is declared at this time of the year. Last year, 4 per cent was voted and paid in quarterly installments. The decision to make no return to shareholders was due to the great falling off in income. During the year ending May 31, 1914, the gross income was $191,632, a falling off of $614,340 from the preceding year. After making allowances for bond interest and reserve, there was a deficit of $59,868, which compared with a surplus of $564,427 in the preceding year. President L. R. Lemoine reported that the company's business "had been unremunerative because of low prices and severe competition for a business which in total volume amounted to less than half that needed for the available capacity of all makers. While low prices have been known before, the present unsatisfactory price markets have continued over a longer period and business managers are in a more or less helpless condition regarding the use of any method for maintaining or advancing the price on their product. That part of the body politic known as the business world can hardly be said to be seized with psycho-neurosis. Rather, the country seems to be involved in a cycle of unrest, distrust and suspicion; an utter lack of confidence, hard to comprehend, but which, nevertheless, exists.

"This condition is not mental illusion. It is caused by hard facts—which suggest a new bondage rather than a new freedom. Until 'uncertainty' and 'lack of confidence' evaporate, a return to normal conditions is unlikely."

The balance sheet showed assets amounting to $30,914,098. Total surplus aggregated $177,418, as compared with $737,285 in the report for the preceding year.

J. C. Brady, son of the late Anthony N. Brady, was elected a director, to succeed his father. Other directors were re-elected.

Opposed to Speculation.—Judge Wm. L. Bennett, of the Superior Court, Hartford, Conn., has declined to authorize the sale of the Pope Mfg. Co., now in the hands of a receiver, for $1,800,000. The plan submitted to the court provided for $400,000 in cash and the remainder in five-year notes. This plan was disapproved by Judge Bennett, who said Connecticut courts never permit receivers to indulge in financial speculation.

Secures Contract

Wheeling Company Obtains Award of Tunnel Segments

The Wheeling Mold & Foundry Co., Wheeling, W. Va., has been awarded a portion of the contract for cast iron tunnel segments for the East River tunnels. The award is for approximately 35,000 to 37,000 tons. This contract was awarded by the main contractors, the Pittsburgh Contracting Co. and the O'Rourke Engineering & Construction Co., who are the combined builders of these tunnels. These castings are for delivery over a period of approximately two years, and shipment will begin in about three months.

This contract was obtained in severe competition and therefore was taken at a very close price. The management of the Wheeling Mold & Foundry Co. deemed it wise to accept the award in order to keep the plant in operation and to give employment to Wheeling labor at a time when such employment is needed very badly. Most of this work will be done in the addition added to the foundry during 1912 and 1913, and will not in any way interfere with the company's regular output.

Awards Contract for Open Hearths

At a meeting of the board of directors of the Youngstown Iron & Steel Co., June 24, the contract for the construction of the proposed plant at Lowellville, O., consisting of three open-hearth furnaces, 75 tons each, a bar mill, slab mill and universal plate mill, was awarded to Julian Kennedy, Pittsburgh. The contract, involving about $1,000,000, calls for completion of the work by April 1, 1915. Between 600 and 800 men will be employed. Hot metal for the open-hearth plant will be furnished by the Ohio Iron & Steel Co.'s Mary furnace nearby, and the product of the plant will be used almost exclusively in the finishing plant of the company in Youngstown. Ground has been reserved as sites for five additional open-hearth furnaces to be added as demand justifies.

Good Showing

Due to Orders for Cars Placed in Preceding Year

The annual report of the American Car & Foundry Co., for the year ended April 30, 1914, shows earnings equal to 5.52 per cent on the $30,000,000 common stock, against 4.09 per cent the previous year. This was after paying 7 per cent on the $30,000,000 preferred stock. The income account for the year compares as follows:

	1914.	1913.
Net earnings	$5,810,889	$5,539,829
*Renewals	2,052,918	2,211,236
Bal. available for divs.	3,757,971	3,328,593
Prfd. dividends	2,100,000	2,100,000
Balance	1,657,971	1,228,593
Common dividends	600,000	600,000
Surplus	1,057,971	628,593
Mainten. & imp.	700,000	250,000
Surplus	357,971	378,593
Prev. surplus	25,255,169	24,876,576
Total surplus	25,613,140	25,255,169

*Renewals, replacements.

F. H. Eaton, president, says in the report: "The gratifying result is not to be ascribed altogether to the improvement in general business but to the fact that at the close of the year 1912-13 the company had contracts for cars sufficient to assure continuous operation for a number of months. The cars under contract at the close of the year were appreciably less than at the close of the preceding period. Since then, however, there has been some improvement. During the year, the buying by railroads has been more or less irregular. They are as yet buying only to meet the pressing necessity, not at all real requirements. The restrictions on their ability, dwelt on in the president's letter of June last, still to a large degree obtain. But at this writing there is evidence that an improvement is impending, which may serve in some measure to alleviate the hardships of which the railroads think they have just cause to complain. Any condition which makes for prosperity of railroads will redound to benefit of your company."

The Whitin Machine Works, Whitinsville, Mass., has announced it will operate its plant on a five-day-per-week schedule hereafter, closing Friday nights. It is understood there are plenty of orders ahead, but orders for immediate delivery are light.

May Not Legalize the Boycott

Senators Not Ready to Pass all the Legislation Demanded by Union Labor Agitators

Washington, June 30.—Information from reliable sources indicates strongly that labor unionism will not succeed in having its pet legislation pass the Senate as it did in the House. Provisions embodying class privileges promise to be eliminated by the upper House. This not only applies to the Clayton omnibus anti-trust bill, but also to the sundry civil bill.

Having combed over the anti-trust bill, the Senate Judiciary Committee, before which it is now being considered, is said to have determined to wipe out provisions sponsored at the dictation of the American Federation of Labor, to which the House so readily bowed. The sundry civil bill clause exempting labor and farmers' organizations from prosecution through the use of money appropriated by that measure, it seems certain, will be stricken from that bill. The President in signing this measure last year, when it carried such a clause, made a statement that it would not prevent prosecution of those organizations through other funds, and asserted that he did not approve such legislation. Regardless of this, however, and despite the vigorous protest from business organizations all over the country against the exemption clause, it was again incorporated this year. President Wilson recently said he did not know the bill again carried the clause, but did not indicate what he would do if the bill were to come to him with that provision incorporated.

In the Senate there are 34 Democrats who may be considered as coming from southern states. They have virtual control over the majority side and are in a position to put through almost any policy they may determine upon. The southern Senators do not have to meet strong opposition from organized labor when campaigning for election, unionism not having so strong a hold in that section as it has in the north. This, therefore, makes the status of labor legislation in the Senate entirely different from that in the House.

It is this that makes the outlook dark for labor unionism in its effort to jam its favorite legislation through the Senate. This should not be taken to mean, however, that some Senators from the north will not oppose privileged legislation in favor of labor unions and other organizations. Nothing more thoroughly indicates the bad straits which labor and other organizations face in the Senate than the fact that a prominent western senator, who is known as a champion of those bodies, has told officials of the American Federation of Labor that they would be "fools"—that is the word said to have been used—to try to force through the senate some of the provisions which went through the House. This senator proposes, according to sources considered reliable, to fight those provisions if they are in the bill when it is laid before the Senate, but it is improbable that they will be allowed to remain when the committee makes its report.

It has been pointed out by this and other senators, although no public statements have been made by them, that two of the most objectionable clauses granting special favors to labor must be killed. One of these relates to legalizing the boycott and the other to picketing. It seems probable, however, that the clause legalizing labor unions—that is, declaring that they are not combinations in restraint of trade—will be allowed to remain. This, to say the least, would be a compromise and would gratify the complaint of President Samuel Gompers, of the American Federation of Labor, that unions are allowed to exist only "by the sufferance of the Department of Justice".

This senator, who is considered a strong friend of organized labor, is said to have told union representatives that they must, for their own welfare, yield to the plan to eliminate the boycott and picketing provisions. He is said to have flatly told them that it will be either "the injunction or the bayonet", meaning that employers will not be bulldozed, and that, if they cannot be protected from labor outrages through legal proceeding, they will obtain their rights by a more drastic manner. Employers, on the other hand, it is declared, will be forbidden the right to do what labor unions call "blacklisting", or not giving employment to union workmen because they are members of a union. The accuracy of this report may be questioned.

The federal trade commission bill was laid before the Senate last week, and although Senator Newlands, chairman of the Interstate Commerce Committee, which has charge of the bill, said he thought it could pass the Senate in a comparatively short time, indications are that it will have been before that body for a protracted period before it is passed. It is expected the omnibus bill will be reported before very long, and it, too, promises to remain before the Senate for considerable time. With these bills and supply measures yet to be disposed of by the Senate, adjournment of Congress seems to be a long way off. Some of the most optimistic place the date at Sept. 15, and others have predicted that this session will come near to running up to the next session in December.

Are Not Alarmed

Filing of a suit for $3,000,000 by the trustee for J. K. Dimmick & Co., Philadelphia coke brokers, against whom involuntary bankruptcy proceedings were begun March 7, 1913, in which 20 leading Connellsville coke producing companies and individual officers are named, has found the latter apparently little perturbed by it. The Dimmick trustee, James B. Coryell, alleges in his petition, filed under the Sherman law, that certain coke companies failed to live up to agreements to sell the Dimmick company coke which it already had sold customers. Allegation is made these companies in thus failing as alleged to keep their agreement, caused the failure of the Philadelphia coke brokers. The defendants are saying little, but they point to the fact the government investigated certain rumors of combination among them long since and nothing ever came of it, the strong inference being they had done nothing illegal. Hence their expressions of confidence in the outcome of this action.

The Van Dorn & Dutton Co., Cleveland, manufacturer of cut and plain gears of every description, has established branch offices in Los Angeles and San Francisco. H. E. Borland is in charge of the Los Angeles office, 1007 North Alameda street, and W. B. Wilson, district sales manager, is in charge of the office at San Francisco, 515 Michigan street. The establishment of these offices is with particular reference to motor gears and pinions.

TIPS FOR NEW BUSINESS

Equipment needs of the Iron and Steel works, Machine shops, Foundries and other Metal Working plants

In New York a few machine tool houses report considerable improvement in the volume of business which they have booked during the past week, while others report that their volume has been less than usual. The largest buyers last week were three manufacturers in the New York district, who bought from $6,000 to $8,000 worth of machinery each. The largest single contract let was one for three gate hoists for use in connection with dam gates for the Cohoes project. New inquiries have been comparatively scarce, especially from the railroads, from which source no business at all recently has originated. Several of the eastern railroads, however, are reported to be preparing machine tool specifications which will be submitted for bids some time after July 1. Just how large these requirements are to be is unknown. Foreign demand for American machinery is reported very dull. The second-hand market is comparatively active, since prospective buyers continue to buy second-hand instead of new machinery, wherever possible. There is a comparatively large volume of business pending in cranes. The government, the largest prospective buyer, is expected to close shortly for the cranes previously reported as being destined for Mare Island and Puget Sound navy yards. Other prospective buyers of cranes are expected to close shortly for the requirements on which bids are in.

Dealers in machine tools and second-hand machinery in Chicago find little to impress them. Business is at a standstill and except for an occasional order, practically nothing is doing. One feature is noticeable, the fact that more second-hand machines are being disposed of by some dealers than new machines, indicating that users are curtailing their expenses as far as possible when forced to add to their equipment.

In Cincinnati machine tool business at the close of June shows that this month has been very unsatisfactory, and the outlook for July is no better. The books of several large machine tool manufacturers show a slight decrease from business done in either April or May. Orders are mostly for single tools, which are about evenly divided between domestic and foreign trade. Manufacturers of special equipment such as laundry, baking or sugar machinery are very busy, especially the former, and this line is by far the best in the machinery industry in this territory. Small electrical equipment is fair, and refrigerating equipment shows a slight increase, as this is usually the good season for manufacturers of this line. Second-hand machinery is slow and unsatisfactory.

EASTERN STATES

BIDDEFORD, ME.—Rutland Foundry & Machine Co. has been incorporated to manufacture, repair and deal in machinery of all kinds, including electrical specialties; $50,000; by J. A. Snow, Scarboro and F. B. Ross, Biddeford.

ROCKLAND, ME.—A. T. Thurston Electric Co. has been incorporated; $10 000; by Albert T. Thurston, Edward B. McAllister, Ambrose A. Peterson, all of this place.

NASHUA, N. H.—E. J. Flather Mfg. Co. has been incorporated; machinery; $25,000; by Ernest J. Flather, Edwin Morey, Charles E. Morey, John R. Spring, Harry E. Flather, all of Nashua.

PORTSMOUTH, N. H.—H. R. Stanford, navy department, Washington, D. C., will receive bids until 11 a. m., July 11, for furnishing and installing at the central power plant here, an after-cooler complete with piping and all accessories.

BOSTON. — The Paulcrow Invention Co., Inc., has been incorporated to manufacture machinery; $50,000; by Edward B. Paul, Winthrop; Aubrey C. Crow, Brookline; and Charles N. Abbott, Cambridge.

LYNN, MASS.—J. H. Nangle Machine Co. has been incorporated; $5,000; by James H. Nangle, Charles H. Morrill and Helen Nangle.

PLEASANT VALLEY, MASS.—The Providence Drapery Rod Co. has let the contract for a building to be erected at Pleasant Valley, near Sutton, Mass. The plans call for a building, 108 feet long, to cost about $20,000, which will be one story and basement. The Providence company will manufacture curtain rods.

SPRINGFIELD, MASS.—American Casket Co. is erecting three buildings at First and Tremont streets in East Springfield; Gour Bros. builders.

WAKEFIELD, MASS.—Disgusted with its failure to settle the strike at its Wakefield factory, where 1,000 men were employed, the Heywood Bros. & Wakefield Co., it is reported, is planning to locate at some point in the middle west, where it is hoped wrangles with the I. W. W. may be avoided. The car seat department, it is understood, will be first to be removed.

NORWICH, CONN.—C. J. Bates & Son are preparing to remodel their plant; they manufacture manicuring goods and instruments.

PINE MEADOW, CONN. — The Chapin & Stevens Co. has purchased the business of the Elmore Tool Co., Hartford, and will erect a forging and grinding building here to take care of the increased business.

NEWPORT, R. I.—As soon as funds can be obtained at the close of the government fiscal year in July, work will start on a $260,000 machine shop to be built of reinforced concrete.

BROOKLYN.—Miller & Van Winkle has been incorporated; wire and steel springs; $150,000; by C. L. Miller, 209 Underhill avenue, Brooklyn and M. Miller and G. P. Brush, Brooklyn.

BUFFALO.—Acme Steel & Malleable Iron Works, Inc., has been incorporated; malleable iron and steel business; $100,000; by A. W. White, W. C. Letchworth and C. J. Brandt, city.

DES PLAINES, N. Y.—Garland Mfg. Co., metal goods, has been incorporated; $35,000; by L. Witthold, C. H. Roe, and H. S. Garland, city.

MANHATTAN, N. Y.—Gas Safety Electric Bell Co. has been incorporated; safety apparatus; $50 000; by D. J. Guccione, A. and M. Angelo Bouo, 52 East 123d street.

MANHATTAN, N. Y.—The National Box-making Machine Co. has been incorporated; $500,000; by W. Scott, 215 West 101st street, N. Y.; B. Hoar and J. E. Donovan, city.

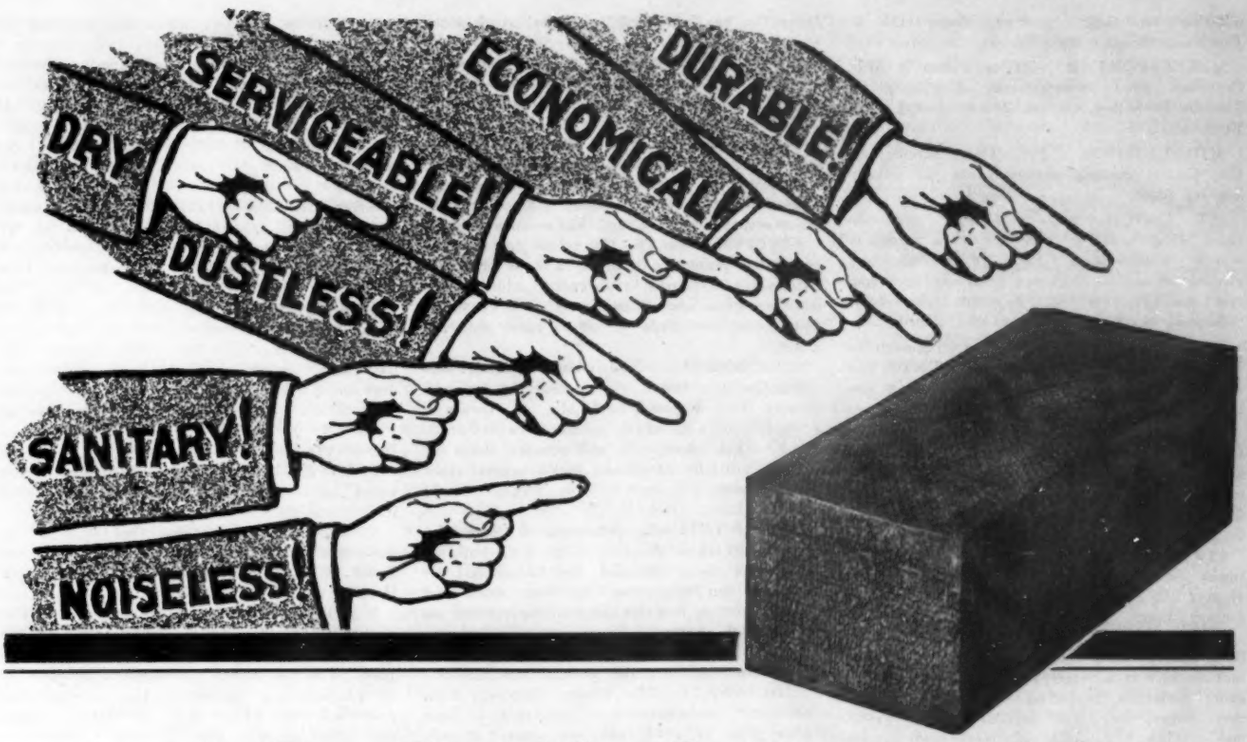
NEW YORK.—Vitagraph Co. will build a $50,000, 4-story brick factory building at Locust and Liberty avenues.

NEW YORK.—Power Service Corporation, gas and power machines, has been incorporated; $250,000; by J. B. Mackie, F. C. Scofield, D. F. O'Connell, 202 Riverside drive.

NEW YORK.—Sanaudres Wireless & Aero Visible Message Co. has been incorporated to develop system of telegraphic optic accoustics on aeroplanes, semaphoric signal system; $100,000; by C. B. Mason, A. Matters and A. Sanaudres, 124 Thompson street.

ROCHESTER, N. Y.—Strombers-Carlson Telephone Mfg. Co. has been incorporated; $450,000; by F. C. Goodwin, W. R. McCanne and W. M. Angle.

BUTLER, PA.—Spang & Co. will erect an



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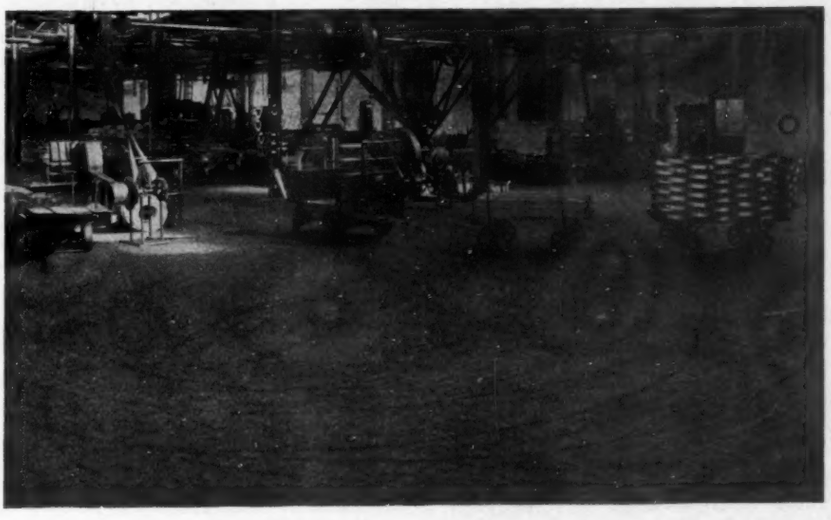

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Always Easy on the Feet
WOOD BLOCKS

addition to their machine shop; O. C. Johnston, South Main street, architect.

McKEESPORT, PA.—Wiley Pump & Mfg. Co. has been incorporated; $100,000; by Thomas F. Wiley, George Turner and Leo S. Reed, city.

MIDDLETOWN, PA.—The Middletown Car Co. is making arrangements for enlarging its plant.

MT. UNION, PA.—A foundry and machine shop will be erected by a company whose stockholders have organized and elected officers as follows; president and general manager, G. R. Reynolds; secretary-treasurer, G. B. M. Kepler.

PHILADELPHIA, PA.—The Philadelphia Electric Co. will erect a 2-story, 39 x 109-foot warehouse and a 59 x 70-foot transmission station; estimated cost, $25,000.

PHILADELPHIA.—Atlantic Iron & Steel Co. has been incorporated to manufacture, sell and deal in iron, steel, timber and other materials; $1,000,000; by F. R. Hansell, Philadelphia; George H. B. Martin and S. C. Seymour, all of Camden, N. J.

PITTSBURGH.—The Peerless Heater Co. upper Seventh street, has bought a site in Beaver Falls, Pa., and will erect a large factory there.

PITTSBURGH.—The Schanman Mfg. Co. has been incorporated under New Jersey laws, to manufacture iron, steel and wire products and other materials, including cement, wood, leather, paper, etc. The capital stock is $100,000. Sarah Hill, John H. Neeb and Joseph Schanman, all of Pittsburgh, are named as incorporators.

TARENTUM, PA. — Borough council will take bids until July 13 for reinforced concrete power house; Leo Hudson, consulting engineer, 1210 House building, Pittsburgh.

WASHINGTON, PA. — The Universal Rolling Mill Co. has increased its capital stock from $200,000 to $3,000 000.

BALTIMORE.—The City Dairy Co. is having plans drawn for its proposed $500,000 plant to be erected at Maryland avenue and Twenty-ninth street.

WASHINGTON, D. C.—Commissioners of the district will receive bids until July 14 for furnishing and delivering electrically driven centrifugal sewage pumps. Specifications obtainable from purchasing officer.

WASHINGTON, D. C.—T. J. Cowie, navy department, will receive bids until July 7 to furnish two milling bench machines, schedule 6942; delivery here; for schedules apply to pay office, nearest navy yard.

WASHINGTON, D. C.—T. J. Cowie, navy department, will receive bids until July 7 to furnish cast iron sewer pipe, schedule 6934; forged and sheet steel, copper belt rivets, schedule 6935, Washington delivery; bar and sheet brass, schedule 6926; pipe fittings and unions, schedule 6927; brass rivet rod, bolt and sheet copper, schedule 6932, delivery Norfolk, Va.; schedules to be had at pay office of nearest navy yard.

WASHINGTON, D. C. — F. C. Boggs, purchasing officer, will receive bids until July 6 for cast iron water pipe and fittings, valves, steel rails, angle bars, frogs, switches, switch stands, steel shapes and plates, steel billets, steel cable, rivets, bolts, boat spikes, turnbuckles, nails, steel washers, galvanized wire lath, copper screening, brass rod, copper bars, sheet copper, sheet brass, bronze bars, staples, lead pipe, motor-driven woodworking shaper, wood trimmers, etc.

CENTRAL STATES

AKRON, O.—The Miller Rubber Co. has purchased site and buildings of the Frantz Body Works. The buildings will be razed and a modern firproof tire factory erected; warehouse also will be built.

CANTON, O.—The Zahner Metal Sash & Door Co. has increased its capital stock from $2,000 to $600,000.

CANTON, O.—Plans have been completed recently for a new passenger station to be erected here for the Northern Ohio Traction & Light Co.

CINCINNATI. — The Corcoran Bros. Co. has acquired a site adjoining its plant, and will build an addition. Plans and specifications have not been prepared. The company manufactures carriage and automobile lamps.

CINCINNATI.—The Cincinnati Ice Co. has completed plans for erecting a new plant on Price Hill and making extensive additions to its Covington and Plum street plants; $600,000 bonds have been issued to cover this expense.

CINCINNATI. — The Dalton Adding Machine Co. has begun the transfer of its machinery from Poplar Bluffs, Mo., to Norwood, a suburb of Cincinnati, where it will be located in the future. It will require about 50 cars to haul the equipment and a special train of workmen will follow from Poplar Bluffs early in July.

CINCINNATI.—L. Schrieber & Sons Co. and the Warner Elevator Mfg. Co., both of Cincinnati, have secured the contracts respectively for furnishing the iron work and elevators for a new building to be erected on East Sixth street, Cincinnati, for Henry Straus. The contracts were let through the Ferro Concrete Co., the general contractors.

CINCINNATI.—The Union Distillery Co., Carthage, Cincinnati, will construct a new boiler plant 57 x 58 feet, one story. It will contain a 266-ton coal bunker, a hydraulic ash lift and two 300-horsepower boilers of the water tube type, with provisions for a duplicate set. G. W. Drach, architect, and Walter G. Franz, consulting engineer, both of Cincinnati are in charge of construction.

CLEVELAND.—The U. S. Smoke Eliminator Co. has been incorporated to manufacture, sell and install smoke eliminators; $10,000; by S. E. Hufford, W. H. Downs, George L. Lenk, Charles E. Cole and C. D. Sutton.

CLEVELAND.—The K-W Ignition Co. will build an addition to its factory at Chester avenue and East Thirtieth street; plans, now ready, call for an 83 x 127-foot steel-trussed structure.

COLUMBUS.—City has voted $265,000 in bonds for extensions to the municipal light plant; finance committee has approved.

COLUMBUS.—The Chesapeake & Ohio railroad has taken up headquarters in the Spahr building here and expects to award contracts in a few weeks for the 94 miles of railroad construction between here and the Ohio river; estimated cost, $9,000,000.

DAYTON, O.—The City Engineering Co. has been incorporated; manufacturer; $25,000; by H. G. Noble, G. E. Ireland, C. A. Donovan, R. E. Scholey and A. D. Heald.

DAYTON, O.—The Scott-Johnston Mfg. Co. has been incorporated; core boxes, general manufacturing and foundry supply business; $10,000; by Wesley M. Scott, William Johnston, Charles H. Romer, Cristella A. Johnston and Mary C. Scott.

HURON, O.—The Huron Cement & Tile Co. plans to enlarge its plant by installing additional machinery; in this connection it has been decided to organize a company with $10,000 capital stock.

KENT, O.—Trustees of Kent State Normal school will receive bids until noon July 11 for agricultural and training building; G. F. Hammond, 4220 Prospect avenue, Cleveland, architect.

MARION, O.—The foundry and core room of the Huber Mfg. Co. were destroyed by fire on June 24, the loss being about $22,000. Several hundred men will be out of employment until repairs can be made.

MASSILLON, O.—The Massillon Electric & Gas Co. has let contracts for reconstructing its present building; additional equipment will be installed when the building is completed.

MENTOR, O.—The Lake Superior Steamship Co. has been incorporated to engage in general steamship building; $250,000; by Frank S. Masten, Tracy H. Duncan, Frederick L. Leckie, B. M. Parker and E. A. Scherer; Mentor Special District, Lake County.

NEW PHILADELPHIA, O.—County commissioners will take bids until July 13 for reinforced concrete and steel bridge over Sugar creek, Franklin township; to have one 100-foot span 16 feet wide.

NORWALK, O.—City has voted $120 000 for a municipal electric light plant.

SANDUSKY, O.—The Way-Cleanse Co. has been incorporated to manufacture and deal in machinery and equipment for sweeping and cleaning streets; $60,000; by George Feick, J. J. Dauch, Bernard Kern, Alfred Hendrickson, William Hendrickson.

SPENCERVILLE, O.—This place has voted to issue $10,000 bonds for rebuilding its electric light plant.

TOLEDO, O.—The Ohio Post & Pipe Co. has been incorporated; $10,000; by G. E. Smith, Gladys Jamison, C. H. Rauch, Frank H. Geer and J. W. Lane.

WARREN, O.—Trumbull Public Service Co. has a contract to supply the plant of the Western Reserve Steel Co. with power. The plant will be driven by electric motors of 2,000-horsepower capacity. The service company will remodel its main generating station and spend a large sum on new boilers, turbines, generators, etc. The steel plant will start operating in six months. W. J. Marshall, of this city, represents the electric company.

YOUNGSTOWN.—Wade D. Holland, Toledo, will build a $100,000 bakery here; work to start within two weeks.

PHILIPPI, W. VA.—Philippi & Clarksburg Traction Co. has been incorporated to build and operate an electric railroad between Philippi and Clarksburg; $25,000; by Samuel V. Woods, J. Hop Woods, R. E. Talbott, Harry H. Byrer, J. C. Watson and E. R. Dyer, all of this city.

WHITESBURG, KY.—The McGlone Bros. Lumber Co., Morehead, Ky., plans to install some large lumber mills near Roxana on the Lexington & Eastern railroad.

GARY, IND. — The Mid-West Diamond Drilling Co. has been incorporated; mining; $20,000; by William L. Brennan, James D. Brennan and John A. Brennan.

INDIANAPOLIS.—Meier Packing Co. has increased its capital stock $35,000.

INDIANAPOLIS. — The Gates Mfg. Co. has been incorporated; auto parts; $20,000; by F. E. Gates, F. O. Lane, R. A. Gates.

INDIANAPOLIS. — County commissioners will receive bids until July 10 for West Washington street bridge over White river; estimated cost, $350,000.

INDIANAPOLIS.—Sun-Lite Gas Co. has been incorporated to manufacture gas machines; $1,000; by O. K. Stuart, city; C. A. Tucker and K. P. Tucker.

MONTICELLO, IND.—The C. A. Schultz Mfg. Co. has been incorporated with a capital stock of $225,000, to manufacture devices for cleaning grain. The directors are, C. P. Ritter, R. D. Cass, C. A. Schultz, R. B. Turner and C. A. Bookwalter.

JOLIET, ILL.—The Aurora, Plainfield & Joliet railroad has been incorported to operate a railroad from Aurora, Kane county, through Plainfield to Joliet, Will county; $25,000; by W. A. S. Mulligan, James E. Hauronic, Robert Oehmig, O. P. Stewart and Frank P. Page.

PEORIA, ILL.—Progressive Engineering Co. has been incorporated; general mining, manufacturing and engineering; $150,000; by Clayton J. Ewing, Geo. H. Beatty, Cagill V. Gerth; Morgan & Zimmerman, attorneys.

DETROIT.—Miller & Eisen have the con-

tract for a 3-story brick factory building to be erected for Massnich-Phipps Mfg. Co., machinists.

GRAND RAPIDS, MICH.—The Michigan Railway Co. has issued $5,000,000 6 per cent 5-year notes, proceeds from which to be used to purchase or construct an interurban line from Flint to Saginaw, Bay City to Saginaw and Kalamazoo to Grand Rapids; also a steam road from Allegan to Battle Creek is now being electrified.

KALAMAZOO, MICH.—The Safety Elevator Stop Co. has been incorporated; $30,000; by E. S. Rankin, A. L. Pratt and John King. It will manufacture automatic lever safeguards and various elevator appliances.

LANSING, MICH.—Michigan State Telephone Co. has completed arrangements for rebuilding the Lansing plant at a cost of $65,000; 500,000 feet of wire will be needed.

LANSING, MICH.—State railroad commission has authorized the following measures: $603,000 bond issue by the Detroit & Port Huron Shore line; increase of capital stock from $1,000,000 to $1,250,000 by the Menominee & Marinette Light & Traction Co.; issue of $68,000 par value corporate bonds by the Detroit, Bay City & Western; $50,000 bond issue by the Detroit United railway.

FOND DU LAC, WIS.—The Wisconsin Southern Railway Co. is advertising for bids for constructing 32 miles of electric railway in Wisconsin.

GRAND RAPIDS, WIS.—The Grand Rapids Foundry Co. is enjoying a heavy run on ice and refrigerating machinery, in addition to keeping busy with its paper mill and other special casting and machinery business. It recently delivered six 6-ton refrigerating machines to the battleship Texas.

MILWAUKEE. — The Youghiogheny & Ohio Coal Co. has secured a permit to install a new unloading bridge at its dock.

MILWAUKEE.—The Milwaukee Locomotive Co., manufacturer of gasoline-driven engines, has increased its capital stock from $50,000 to $250,000.

MILWAUKEE.—International Electric Tool Co. has been incorporated; $20,000; by W. H. Gaulke, E. K. Rundle, W. R. Sorgel, E. L. Wood.

MILWAUKEE.—The Nordberg Mfg. Co. is completing work on a large compound condensing steam hoist for the Homestake Mining Co., Lead, S. D. The hoist is said to be the largest in the world and was designed by Bruno V. Nordberg, president and chief engineer. The shipment will require 27 cars.

MILWAUKEE. — The Falk Co. announces that it has sold its entire kerosene engine business and rights to the M. Rumely Co., LaPorte, Ind., and within 60 days will transfer its entire kerosene gas engine equipment to LaPorte. The Falk people perfected a high efficiency type of internal combustion engine using kerosene and the heavier distillates of petroleum as fuel and were producing 3,000 of these engines yearly. The Falk company will devote its entire attention to the production of steel specialties, notably intricate railroad track work, frogs, cut-overs, etc.

RACINE, WIS.—The Hamilton-Beach Mfg. Co., electrical specialties, vibrators, mixers, vacuum cleaners, etc., will build a $60,000 plant at Racine before the end of the year. Plans are being drawn by Guilbert & Funston for a 3-story brick and steel factory, to be located at Rapids Road and High street, on the main line of the Chicago & North-Western.

WAUSAU, WIS.—The Badger Paper & Bag Co. has awarded the general contract for planning and constructing a $100,000 addition to its plant to Louis A. DeGuere, Grand Rapids, Wis. It will be of steel and tile construction, 146 x 132 feet, two stories and will require about 200 tons of steel.

JOPLIN, MO.—S. R. Ping who a few months ago purchased the 32-acre Maggie Taylor tract, part of which is virgin mining ground giving good zinc tests, has started work on a mill; it will operate as the Portia Mining Co.

KEWANEE, MO.—Kewanee Water Supply Co. has increased its capital stock from $200,000 to $250,000.

PINEVILLE, MO.—July 15 at 2 p. m., the contract will be let by public outcry for material to be shipped to the nearest railroad station for a steel bridge across Big Sugar creek near Powell. For special information address county court of McDonald county, Mo.

SAVANNAH, MO.—J. E. Schnitzius, Andrew county engineer, will receive bids until July 8, 2 p. m., for concrete and steel bridges and culverts.

ST. LOUIS.—Helmer Construction Co. has increased its capital stock from $36,000 to $60,000.

ALBIA, IA.—S. Q. Hunter, of Atlantic, will open a factory for galvanized tubes and foundry work near the C. B. & Q. depot.

KEOKUK, IA.—A wire fence industry is moving here from Kokomo, Ind., and has been incorporated at $25,000. Casper Butler, owner, who operated the plant at Kokomo, decided to come here instead of rebuilding his plant which was wrecked by fire last August.

MARSHALLTOWN, IA.—Iowa Railway & Light Co. has plans ready for enlarging and partially rebuilding its gas and electric plants; work to start this month; estimated cost, $50,000.

OSKALOOSA, IA.—Ideal & Mfg. Supply Co. has purchased the old Harrington foundry which it will reopen and use for making castings.

WAPELLO, IA.—M. Hunter, city recorder, will receive bids until July 9 for 3,682 feet of 4-in. water pipe and necessary hydrants, valves and fittings.

McINTOSH, MINN.—Southmayd & Webster, makers of agricultural implements, are laying the foundation for their proposed machine shop.

CROOKSTON, MINN.—It is reported that county commissioners will take bids until July 13 for two steel bridges across Poplar river.

ST. PAUL, MINN.—Twin City Rapid Transit Co. is erecting an addition to its plant and repair shops on Snelling avenue.

SOUTHERN STATES

WILMINGTON, N. C.—Major H. W. Stickle, U. S. engineer, will receive bids until noon July 10 for 1,576 tons of steel sheet piling and accessories.

DAYTONA, FLA.—The board of public works will receive bids until July 15 for the following: 430 tons cast iron pipe; 16,000 linear feet of 2-inch galvanized iron pipe; two 50-horsepower oil engines, three centrifugal pumps, and air compressors with appurtenances; Riensch sewage screen; sterilizing outfit; installing machinery in sewage pumping station; seven sewage ejectors; 400 flush tanks and manholes; three miles of cast iron pipe; 4,000 linear feet of 30-inch reinforced concrete pipe, etc.; plans and specifications forwarded by engineer for $5.00.

BATESVILLE, MISS.—Board of supervisors will receive bids until July 13 to build 1.420-foot steel trestle on Belmont levee; plans and specifications with R. M. Draper, chancery clerk.

NEW ORLEANS.—Department of public finances will take bids until July 9 for a Scherzer rolling lift bridge on Old Basin canal at Broad street; A. G. Ricks, city commissioner.

LITTLE ROCK, ARK.—The Northwestern Steel & Iron Works has been incorporated; $25,000; by E. R. Hamilton, Henry McDonnell, et. al.

PRINCETON, ARK. — The Free Valley railroad has been incorporated to construct a 25-mile railroad between here and Eagle Mills; $50,000; by Edward Bower et al.; Little Rock.

MEMPHIS, TENN.—C. C. Pashby, city clerk, will receive bids until July 14 for pumping station and equipment; plans with J. H. Weatherford, city engineer.

ALEX, OKLA.—The Alex Mill & Elevator Co. has been incorporated; $6 000; by P. D. Pruitt, Lindsay; George Caldwell and Nettie F. Caldwell, Alex.

GOODWELL, OKLA. — Oklahoma state board of agriculture, Oklahoma City, will receive bids until noon, July 20 for girls dormitory, shops and heating plant to be erected at the Panhandle Agricultural Institute; estimated cost, $20,000.

WESTERN STATES

WILLISTON, N. D. — L. C. Fields, county auditor, will receive bids until July 9, for 10 steel bridges.

HUMBOLDT, S. D.—Town clerk will take bids until July 10 for constructing water works to cost about $10,000.

HERMAN, NEB.—Board of trustees will receive bids until noon July 6, for a water works system; plans with village clerk; Towl Engineering Co., 1123 City National Bank building, Omaha, Neb., engineer.

OMAHA, NEB. — The Grain Exchange building to be erected here will be an 8-story structure to cost about $250,000.

LINDSBORG, KAN.—J. W. Quinn, county clerk, McPherson, will take bids until July 8 for a bridge over Smokey Hill river at this place; estimated cost, $16,000.

JACKSON, WYO. — U. S. Reclamation Service will take bids until July 22 at Boise, Ida., for a highway bridge of three 130-foot steel truss spans with wooden trestle approaches, across South Fork Snake river near here.

LAS ANIMAS, COLO.—H. R. Stanford, navy department, Washington, D. C., will take bids until 11 a. m., July 11 for four 100-horsepower water tube boilers, a fan and motor, valves, piping, etc., for central power plant, U. S. Navy Hospital.

CHALLIS, IDA. — County commissioners, E. J. Michael, clerk, will receive bids until July 11 for constructing a 140-foot steel span bridge across the Salmon river 12 miles below here; for constructing a 164-foot steel span bridge and a 150-foot steel span bridge across the Salmon river near Clayton; contract awarded will depend for its fulfillment on whether bonds are voted by the county.

STITES, IDA.—A. K. McAlpine will build a band saw mill near here with 40,000-foot daily capacity; also a planing mill.

MAYS, WASH.—C. A. and J. C. Butler, of Ballard, a suburb of Seattle, will erect a 90,000-daily capacity shingle mill here.

SEATTLE, WASH.—The Snoqualmie Falls Lumber Co. has been incorporated at $3 000,000; by O. D. Fisher, W. D. McCormick, John P. Weyerhauser, and G. W. Grandin, city; Geo. S. Long, Tacoma.

WHITE SALMON, WASH.—The Northwestern Electric Co. starts work soon on another power house on the White Salmon river about 12 miles from here.

HOULTON, ORE. — County court, St. Helens, will take bids until July 6 for two steel spans near railway station, Houlton. H. L. Bowlby, state highway engineer, Portland.

TILLAMOOK, ORE.—F. D. Small and D. C. Urie have been granted a light and power franchise and will spend approximately $30,000 on the project.

IRON AND STEEL PRICES

Corrected up to Tuesday noon

PIG IRON

(Delivery Through Third Quarter.)

Bessemer, valley	$14.00
Bessemer, Pittsburgh	14.90
Basic, Pittsburgh	13.90
Basic, eastern Pa.	14.00
Malleable, Pittsburgh	13.90 to 14.40
Malleable, Chicago	14.00
Malleable, Philadelphia	15.50 to 15.75
Malleable, Buffalo	13.00 to 13.50
No. 1X Philadelphia	15.00 to 15.25
No. 2 foundry, Pittsburgh	13.90 to 14.40
No. 2 foundry, Cleveland	13.75 to 14.25
No. 2 foundry, Ironton	13.50
No. 2 foundry, Chicago	14.00
No. 2X foundry, Philadelphia	14.75 to 15.00
No. 2X foundry, New York	14.50 to 14.75
No. 2X foundry, Buffalo	13.00 to 13.50
No. 2 plain, Philadelphia	14.50 to 14.75
No. 2 plain, New York	14.25 to 14.50
No. 2 plain, Buffalo	13.00 to 13.25
No. 2 southern, Birmingham	10.25 to 10.50
No. 2 southern, Cincinnati	13.50 to 13.75
No. 2 southern, Chicago	14.85 to 15.85
No. 2 southern, Philadelphia	15.00 to 15.25
No. 2 southern, Cleveland	14.60 to 14.85
No. 2 southern, New York	14.75 to 15.00
No. 2 southern, St. Louis	14.50 to 15.00
Virginia, 2X, Philadelphia	15.30
Virginia, 2X, Jersey City	15.85 to 16.10
Virginia, 2X, New Eng., all rail	16.25
Gray forge (eastern Pa.)	13.75 to 14.00
Gray forge, Pittsburgh	13.65
Gray forge, Birmingham	9.25 to 9.50
Silveries, 8 per cent, Cleveland	17.55
Silveries, 5 per cent, Birmingham	12.50
Silveries, 5 per cent, Chicago	16.85
Standard low phos., Phila.	20.50
Lebanon low phos., furnace	17.00 to 17.50
Low phos., Pittsburgh	21.65 to 21.90
Charcoal, Lake Superior, Chgo., Nos. 1 to 4	15.75 to 16.50
Charcoal, Buffalo	15.75 to 16.75
Charcoal, Birmingham	25.00
Middlesbrough, No. 3, Phila., ex ship	15.00 to 15.25

IRON ORE

(Lower lake ports.)

Old range Bessemer, 55 per cent	$3.75
Mesabi Bessemer, 55 per cent	3.50
Old range, non-Bess., 51½ per cent	3.00
Mesabi, non-Bessemer, 51½ per cent	2.85

(Per unit Philadelphia.)

Foreign Bess., 50 to 65 per cent	7 to 8c
Foreign non-Bess., 50 to 65 per ent.	7 to 8c

COKE

(At the ovens.)

Connellsville furnace	$1.75 to 1.85
Connellsville fur. contr.	1.85 to 2.00
Connellsville foundry	2.35 to 2.60
Connellsville fdy., contr.	2.40 to 2.65
Wise county furnace	1.90 to 2.10
Wise county foundry	2.25 to 2.75
Pocahontas furnace	1.90 to 2.05
Pocahontas foundry	2.25 to 2.40
New River, foundry	2.75 to 3.50
New River, furnace	2.20 to 2.35

FERRO-ALLOYS

Ferro-manganese, Baltimore	$38.00
Ferro-silicon, 50 per cent, Pbgh.	71.00 to 73.00
Ferro-silicon, 50 per cent, Phila.	71.00 to 73.00
Ferro-sil., 12 to 13 per cent, Pgh.	22.90
Ferro-sil., 11 to 12 per cent, Pgh.	21.90
Ferro-sil., 10 to 11 per cent, Pgh.	20.90
Ferro-sil., 9 to 10 per cent, Pgh.	19.90
Ferro-carbon titanium, carloads, per lb.	8c to 12½c

SEMI-FINISHED STEEL

Bess. billets, Pbgh. and Yn.	$19.50 to 20.00
Open-hearth bil., Pbgh. and Yn.	19.50 to 20.00
Open-hearth bil., Phila.	21.90 to 22.40
Bess. sheet bars, Pbgh. and Yn.	20.50 to 21.00
Op.-h'th sh. bars, Pbgh. & Yn.	20.50 to 21.00
Forging billets, Phila.	26.40 to 27.40
Forging billets, Pittsburgh	24.00 to 25.00
Wire rods, Pittsburgh	25.00

RAILS AND TRACK MATERIAL

Stand. Bess., rails, Pbgh.	1.25c
Stand. open-hearth rails, Pbgh.	1.34c
Light rails, 8 lbs., Pbgh. or Chi.	1.40c
Lgt. rails, 12 lbs., Pbgh. or Chgo.	1.35c
Lgt. rails, 16 to 20 lb., Pbgh. or Chicago	1.30c
Lgt. rails, 25 to 45 lbs., Pbgh. or Chicago	1.25c
Relaying rails, standard, Chgo.	$23.00 to 24.00
Relaying rails, light, Chicago	21.50 to 22.50
Angle bars, st. sect. Pbgh., base	1.50c
Angle bars, st., sections, Chgo.	1.50c
Spikes, railroad, Pbgh.	1.40c to 1.45c
Spikes, railroad, Chgo.	1.55c
Track bolts, Pbgh.	2.00c
Track bolts, Chgo.	2.00c

SHAPES, PLATES AND BARS

Structural shapes, Pittsburgh	1.10c to 1.15c
Structural shapes, Chicago	1.28c to 1.33c
Structural shapes, Philadelphia	1.25c to 1.30c
Structural shapes, New York	1.26c to 1.31c
Structural shapes, San Francisco.	2.00c to 2.05c
Tank plates, Chicago	1.28c to 1.33c
Tank plates, Pittsburgh	1.10c to 1.15c
Tank plates, Philadelphia	1.25c to 1.30c
Tank plates, New York	1.26c to 1.31c
Bars, soft steel, Pittsburgh	1.10c to 1.15c
Bars, soft steel, Chicago	1.28c to 1.33c
Bars, soft steel, Philadelphia	1.30c
Bars, soft steel, New York	1.31c
Hoops, carloads, Pittsburgh	1.25c

Freight Rates, Finished Material

From Pittsburgh, carloads, per 100 pounds, to:—

New York	16 cents
Philadelphia	15 cents
Boston	18 cents
Buffalo	11 cents
Baltimore	14½ cents
Cleveland	10 cents
Cincinnati	15 cents
Chicago	18 cents
Minneapolis and St. Paul	32 cents
Denver	67½ cents
St. Louis	22½ cents
New Orleans	30 cents
Birmingham	45 cents
Pacific coast, plates and shapes	80 cents

Hoops, less carloads, Pittsburgh	1.30c
Bands, Pittsburgh	1.10c to 1.15c
Shafting, carloads, Pbgh., disc. contract	66
Shaft'g carloads, Pbgh., prompt,	67
Shaft'g less carl'ds, Pbgh., disc.	63
Bar iron, Chicago	1.05c to 1.10c
Bar iron, Philadelphia	1.20c to 1.25c
Bar iron, New York	1.25c to 1.30c
Bar iron, Cleveland	1.20c to 1.25c
Bar iron, Pittsburgh	1.25c
Hard steel bars, Chicago	1.25c to 1.30c
Smooth finish'g mchy. steel, Chi.	1.68c

SHEETS AND TIN PLATE

No. 28, black, Pittsburgh	1.80c to 1.90c
No. 28, black, Chicago	1.93c to 1.98c
No. 28, tin mill, black, Pbgh.	1.80c to 1.90c
No. 28, galvanized, Pbgh.	2.75c to 2.85c
No. 28, galvanized, Chgo.	2.88c to 2.93c
No. 10, blue annealed, Pbgh.	1.35c
No. 10, blue annealed, Phila.	1.50c
Tin plate, 100 lb., coke, base	$3.30 to 3.40

IRON AND STEEL PIPE

(Pittsburgh.)

	Black Butt-weld.	Galv. Butt-weld.
Steel, ¾ to 3 inches	80	71½
Iron, ¾ to 2½ inches	70	61
	Lap-weld.	
Steel, 2½ to 6 inches	79	70½

BOILER TUBES

Steel, 3½ to 4½ inches	73
Iron, 3½ to 4½ inches	60

WIRE PRODUCTS

Wire nails, jobbers, Pittsburgh	$1.50 to 1.55
Wire nails, retailers, Pittsburgh	1.55 to 1.60
Plain wire, jobbers, Pittsburgh	1.30 to 1.35
Plain wire, retailers, Pittsburgh	1.35 to 1.40
Galvanized wire, jobbers, Pbgh.	1.70 to 1.75
Galvanized wire, retailers, Pbgh.	1.75 to 1.80
Polished staples, Pbgh.	1.50 to 1.55
Galvanized staples, Pbgh.	1.90 to 1.95
Barb wire, painted, jobbers, Pbgh.	1.50 to 1.55
Barb wire, painted, retail'rs, Pbgh.	1.55 to 1.60
Barb wire, galv., retailers, Pbgh.	1.95 to 2.00
Barb wire, galv., jobbers, Pbgh.	1.90 to 1.95

BOLTS AND NUTS

(Delivered within 20-cent freight radius.)

Carriage bolts, ⅜ x 6 inches, smaller or shorter, rolled threads, 80 and 10; cut threads, 80 and 5; larger or longer, 75 and 10.

Machine bolts with hot pressed nuts ⅜ x 4 inches, smaller or shorter, rolled, 80 and 15; cut, 80 and 10; larger or longer, 75 and 15.

Gimlet and cone point lag or coach screws, 80 and 20.

Hot pressed square, blank or tapped nuts, $6.30 off list; hot pressed hexagon blank or tapped, $7.20 off.

Cold pressed, C. & T. square, blank or tapped, $6 off; hexagon, blank or tapped, ⅜ inch and larger, $7.20; ⅜-inch and smaller, $7.80.

RIVETS

Structural rivets, Pbgh.	1.50c to 1.65c
Structural rivets, Chgo.	1.68c
Boiler rivets, Pbgh.	1.60c to 1.75c
Boiler rivets, Chgo.	1.78c

SCREWS

(New York.)

Lag, gimlet and cone point	80 and 20
Coach, gimlet point	80
Standard jack	70 and 10
Mch., cut thread, flat head	50 and 10
Mach., cut thread, round head	50 and 10 and 10
Mch., cut thread, fillister hd.	40 and 40 and 10
Mch., rolled thread, flat head or round head	80 and 10
Set screws, iron	75 and 10 and 10
Set screws, steel, per cent advance over iron	25
Square head cap screws	70 and 10 and 10
Hexagon head cap screws	70 and 10 and 10
Fillister head cap screws	60 and 10 and 10
Flat head wood screws	10 and 10 and 5
Round head wood screws	10 and 10 and 5

WASHERS

(Discounts, Iron or Steel, to Jobbers, Cleveland.)

⅛-inch	$7.25
⅜-inch	7.00
½-inch	7.00
⅝-inch	7.00
¾-inch	7.00

STEEL SHEET PILING

(Pittsburgh.)

Base sizes	1.55c to 1.60c

TWISTED REINFORCING BARS

(Soft steel, Pittsburgh mill.)

¾-inch and larger	1.25c
⅝-inch	1.30c
½-inch	1.35c
⅜-inch	1.50c
¼-inch	1.75c

IRON AND STEEL PRICES

Corrected up to Tuesday noon

TACKS

(New York.)—

	Discount.
American carpet tacks	90 and 20 and 10
American cut tacks	90 and 20 and 10
Railroad tacks	90 and 40
Gimp tacks	90 and 20 and 10
Finishing nails	70

WIRE ROPE

Galvanized, iron and steel	47½ and 2½
Bright, Iron and steel	55 and 2½

TRIANGLE REINFORCING MESH

(Per 100 square feet f. o. b. mill, car loads.)

No. 4, plain	$1.00
No. 4, galvanized	1.12
No. 7, plain	.49
No. 7, galvanized	.55
No. 23, plain	1.69
No. 23, galvanized	1.88
No. 26, plain	1.17
No. 26, galvanized	1.30
No. 27, plain	.96
No. 27, galvanized	1.07
No. 31, plain	2.49
No. 31, galvanized	2.76
No. 35 plain	1.17c
No. 35 galvanized	1.30
No. 39, plain	3.05
No. 39, galvanized	3.38
No. 43, galvanized	1.23
No. 43, plain	1.10

SPIRAL RIVETED PIPE

(Per 100 linear feet, f. o. b. factory.)

4-inch, plain	$ 19.76
4-inch, galvanized	30.74
6-inch, plain	33.05
6-inch, galvanized	49.73
8-inch, plain	43.17
8-inch, galvanized	65.00
10-inch, plain	66.42
10-inch, galvanized	96.15
12-inch, plain	83.75
12-inch, galvanized	118.30
14-inch, plain	99.14
14-inch, galvanized	138.85
16-inch, plain	117.53
16-inch, galvanized	166.58
20-inch, plain	183.79
20-inch, galvanized	248.39
24-inch, plain	219.92
24-inch, galvanized	293.99
30-inch, plain	324.81
30-inch, galvanized	430.64

CAST IRON PIPE

Three to 24 in., Cleveland	$22.35 to 22.80
Four-inch, water, Chicago	26.50
Six to 12 inches, Chicago	24.50
Larger sizes, Chicago	24.00
Six inch, water, New York	20.50 to 21.50
Four-inch, water, Birmingham	21.50
Six-inch and larger, Birmingham	19.50

Gas pipe, $1 per ton higher than water.

WAREHOUSE PRICES

Steel bars, Chicago	1.65c
Steel bars, Cleveland	1.80c
Steel bars, Cincinnati	1.70c to 1.85c
Steel bars, Philadelphia	1.65c to 1.70c
Steel bars, New York	1.80c
Iron bars, Chicago	1.65c
Iron bars, Cleveland	1.75c
Iron bars, Cincinnati	1.65c to 1.75c
Iron bars, Philadelphia	1.60c to 1.65c
Iron bars, New York	1.65c to 1.70c
Hoops, Chicago	2.15c
Shapes and plates, Chicago	1.75c
Shapes and plates, Cleveland	1.90c
Shapes and plates, Cincinnati	1.80c to 1.90c
Shapes and plates, Philadelphia	1.65c to 1.70c
Shapes and plates, New York	1.85c
No. 10 blue ann. sheets, Chgo.	1.85c
No. 10 blue ann. sheets, Cleve.	2.15c
No. 10 blue ann. sheets, Cinci.	1.95c
No. 28 black sheets, Chgo.	2.45c
No. 28 black sheets, Cleveland	2.60c
No. 28 black sheets, Cincinnati	2.45c to 2.55c
No. 28 galv. sheets, Chgo.	3.45c
No. 28 galv. sheets, Cleveland	3.60c
No. 28 galv. sheets, Cincinnati	3.45c to 3.55c

IRON AND STEEL SCRAP

(Net tons.)

No. 1 railroad wrought Chgo.	$ 9.00 to 9.25
No. 1 railroad wrought, Cleve.	9.50 to 10.00
No. 1 railroad wrought, St. L.	7.75 to 8.00
No. 1 railroad wrought, Cinci.	8.00 to 8.50
No. 2 railroad wrought, Chgo.	8.75 to 9.00
No. 2 railroad wrought, St. L.	7.50 to 7.75
Arch bars and transoms, Chgo.	12.25 to 12.50
Arch bars and transoms, St. L.	11.00 to 11.50
Knuckles, coup. and spr'gs, Chgo.	9.00 to 9.50
Knuckles, coup. & sp'gs, St. L.	9.25 to 9.50
Shafting, Chicago	11.50 to 12.00
Shafting, St. Louis	13.00 to 13.50
Steel car axles, Chgo.	12.00 to 12.25
Steel car axles, St. Louis	11.75 to 12.25
Locomotive tires, Chicago	9.25 to 9.50
Locomotive tires, St. Louis	8.75 to 9.25
Cut forge, Chicago	8.75 to 9.00
Pipes and flues, Chicago	6.75 to 7.00
Pipes and flues, Cleveland	7.75 to 8.25
Pipes and flues, St. Louis	5.75 to 6.25
No. 1 cast, Chicago	9.75 to 10.00
No. 1 cast, Cleveland	10.00 to 10.50

Freight Rates, Coke

Connellsville regions, per 2,000 lbs., to:—	
Baltimore	$1.80
Buffalo	1.85
Chicago	2.50
Cleveland	1.60
Detroit	2.10
East St. Louis	2.80
Joliet	2.50
Louisville	2.50
Milwaukee	2.70
New York	2.85
Philadelphia	2.05
Pittsburgh	.75
Richmond, Va.	2.94
Toledo	1.85
Valley furnaces	1.20
Cincinnati	2.00

No. 1 cast, Cincinnati	$ 9.25 to 9.75
No. 1 cast, St. Louis	9.50 to 10.00
No. 1 busheling, Chicago	7.50 to 7.75
No. 1 busheling, Cleveland	8.50 to 9.00
No. 1 busheling, Cincinnati	6.00 to 6.50
No. 1 busheling, St. Louis	7.25 to 7.50
No. 2 busheling, Chicago	6.00 to 6.25
No. 1 boiler plate, cut, Chgo.	6.50 to 7.00
No. 1 boiler plate, cut, Buffalo	9.00 to 9.50
No. 1 boiler plate, cut, St. L.	6.00 to 6.50
Boiler punchings, Chicago	9.00 to 9.25
Cast borings, Chicago	4.75 to 5.25
Cast borings, Cleveland	6.00 to 6.25
Cast borings, Cincinnati	4.25 to 4.75
Cast borings, St. Louis	4.00 to 4.50
Machine shop turnings, Chgo.	5.25 to 5.50
Machine shop turnings, Cleve.	5.50 to 5.75
Machine shop turnings, Cinci.	4.50 to 5.00
Machine shop turnings, St. L.	4.50 to 5.00
Malleable, agl., Chicago	7.75 to 8.25
Malleable, agricultural, St. Louis	7.50 to 8.00
Malleable, railroad, Chicago	8.75 to 9.00
Malleable, railroad, Cincinnati	6.50 to 7.00
Malleable, railroad, St. Louis	7.50 to 8.00
Angle bars, iron, Chgo.	11.75 to 12.25
Angle bars, iron, St. Louis	10.00 to 10.50
Angle bars, steel, Chgo.	8.25 to 8.75
Angle bars, steel, St. Louis	9.25 to 9.50
Stove plate, Chicago	8.50 to 8.75
Stove plate, Cleveland	7.75 to 8.00
Stove plate, Buffalo	9.75 to 10.00
Stove plate, Cincinnati	6.50 to 7.00
Stove plate, St. Louis	8.25 to 8.75
Bundled sheet, Cincinnati	4.75 to 5.25
Wrought iron pil'g plates, Clev.	13.00

(Gross Tons.)

Heavy melting steel, Pbgh.	$12.00
Heavy melting steel, Buffalo	10.00 to 10.50
Heavy melting steel, Chicago	9.50 to 9.75
Heavy melting steel, Cleveland	10.25 to 10.75
Heavy melting steel, Cincinnati	9.00 to 9.50
H'vy melting steel, eastern Pa.	10.50 to 11.00
Heavy melting steel, New York	8.50 to 8.75
Heavy melting steel, St. Louis	11.00 to 11.50
Bundled sheet, Buffalo	6.25 to 6.50
Grate bars, Buffalo	9.50 to 10.00
Grate bars, New York	5.75 to 6.00
No. 1 railroad wr'ght, east. Pa.	12.50 to 12.75
No. 1 railroad wrought, Pbgh.	11.50 to 12.00
No. 1 R. R. wght., New York	10.25 to 10.50
No. 1 R. R. wrought, Buffalo	11.00 to 11.50
Shafting, New York	12.00 to 12.50
Pipes and flues, New York	8.00 to 8.25
Pipes and flues, eastern Pa.	9.25 to 9.75
Mch. shop turnings, New York	5.75 to 6.00
Machine shop turnings, Buffalo	5.50 to 6.00
Mch. shop turnings, Pbgh.	7.75 to 8.00
Mch. shop turnings, eastern Pa.	7.50 to 8.00
Cast borings, New York	5.75 to 6.00
Cast borings, eastern Pa.	8.00 to 8.50
Cast borings, Buffalo	6.00 to 6.50
Cast borings, Pittsburgh	8.00 to 8.25
Stove plate, (Jersey points)	8.50 to 8.75
Stove plate, Pittsburgh	10.00 to 10.25
Stove plate, eastern Pa.	8.50 to 9.00
Shoveling steel, Chicago	9.00 to 9.50
Shoveling steel, St. Louis	8.00 to 8.25
Reroll'g rails, 5 ft. & ov., Pbgh.	13.00 to 13.25
Reroll. rails, 5 ft. and ov., Chgo.	11.25 to 11.75
Reroll. rails, 5 ft. and ov., Cleve.	11.00 to 11.50
Reroll. rails, 5 ft. & ov., E. Pa.	12.25 to 12.75
Reroll. rails, 5 ft. and ov., St. L.	11.25 to 11.50
Steel rails, short, Chicago	10.25 to 10.50
Steel rails, short, Cleveland	13.00 to 13.25
Steel rails, short, eastern Pa.	11.00 to 11.25
Steel rails, short, St. Louis	10.50 to 10.75
Iron rails, Cleveland	13.50 to 14.00
Iron rails, Cincinnati	10.50 to 11.00
Iron rails, eastern Pa.	15.00 to 16.00
Iron rails, St. Louis	11.00 to 11.25
Frogs, switches, guards, Chgo.	9.50 to 9.75
Frogs, switches and g'rds, St. L.	10.50 to 10.75
Car wheels, (iron), Pittsburgh	11.25 to 11.50
Car wheels, (steel), Pittsburgh	12.25 to 12.50
Car wheels, Chicago	10.75 to 11.00
Car wheels, eastern Pa.	11.25 to 11.50
Car wheels, Buffalo	12.00 to 12.50
Car wheels, N. J. points	10.50 to 11.00
Car wheels, St. Louis	11.00 to 11.25
Iron axles, Pittsburgh	22.00 to 22.50
Iron axles, Cincinnati	19.00 to 20.00
Iron axles, eastern Pa.	20.00 to 21.00
Iron axles, Buffalo	21.50 to 22.00
Iron axles, Chicago	19.00 to 19.50
Steel car axles, New York	12.25 to 12.75
Steel car axles, Buffalo	15.00 to 15.50
Steel car axles, Cleveland	14.00 to 16.00
Steel car axles, eastern Pa.	14.00 to 14.50
No. 1 busheling, Buffalo	8.50 to 9.00
No. 1 busheling, Pittsburgh	10.00 to 10.25
No. 2 busheling, Buffalo	6.00 to 6.50
Low phosphorus steel, Buffalo	15.00 to 15.50
Low phosphorus steel, Pbgh.	14.00 to 14.25
Low phos. steel, eastern Pa.	14.50 to 15.00
No. 1 forge, eastern Pa.	8.50 to 9.00
No. 1 cast, eastern Pa.	12.00 to 12.50
No. 1 cast, Pittsburgh	12.00 to 12.25
No. 1 heavy cast (N. J. points)	11.50 to 11.75
Boiler plate, Cleveland	8.50 to 9.00
Mall. iron, agricul., Cleveland	9.00 to 9.50
Mall. iron R. R. Cleveland	10.75 to 11.25
Malleable, railroad, Pittsburgh	10.50 to 10.75
Malleable R. R. Buffalo	10.75 to 11.25
Mall., R. R. east. Pa.	9.00 to 9.50
Bundled sheet, Pittsburgh	8.50 to 8.75
Bundled sheet, Cleveland	7.50 to 8.00

MISCELLANEOUS SHOP TOOLS

	Discount.
Standard files	80 and 5
Heavy hammers, 3 to 5 lb.	80 and 10
Heavy hammers, over 5 lb.	80 and 5
Gas pliers, 7-inch, per dozen	$2.00
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Hardness Tests

(*Continued from page* 24).

scleroscope measures the hardness of very small areas, and these areas vary in hardness even in the same metal. It has been found that for hardness numbers above 300 Brinell or 45 scleroscope, the metals are very difficult to machine. Tempered steels lie in the range of 150 to 300 Brinell. No attempt has been made to compare the accuracy or usefulness of the two instruments, as it is believed that each of them has a place in the testing of materials.

How to Test Metallic Coatings

(*Continued from page* 36).

led us to produce a rain in the laboratory by sending a stream of water through an ordinary rosette such as is used with a gardener's watering can. The results were encouraging, but too severe, because the individual streams played steadily on one spot and produced erosion. Then we tried an atomizing nozzle, projecting a cloud of moisture into a chamber in which the test specimens were exposed; the results were better, but there was still a possibility of some wear if the article was directly in the path of the stream, and near to the nozzle. The problem seemed to be solved when care was taken in placing the articles to keep them out of the direct path of the jet issuing from the atomizing nozzle.

As experience was gained with this type of test, as applied to insulating material, it was found that what seemed to be the essential requirement was the maintaining of an atmosphere substantially saturated with moisture; and this saturated-atmosphere exposure has been one of the tests regularly applied to all insulating materials intended for out-door use since it was first worked out some 15 years ago. It has been found to give reliable indications of the ability of insulation to resist weather, except, of course, as such ability is affected by extremes of heat and cold, erosion from the wind carrying dust particles, etc.

The problem of determining the resistance of protective coating to weather corrosion is very similar to that of testing insulations for their weathering qualities. The conditions of exposure are the same, and hence there seemed to be no essential reason why the saturated-atmosphere test would not apply equally well to protective coatings as to insulation. Tests were begun several years ago to try out the method, and the only fault found with it was that it was somewhat slow. Good coatings did not show any signs of breaking down after several weeks of continuous exposure to the fog; yet there was encouragement in the fact that bare metal began rusting in a few hours, and rust spots began developing on poorly protected surfaces in from a few days to a week.

The fact that more trouble is experienced with trolley-line suspensions along the seashore than with the same devices inland, led immediately to the trial of an atmosphere saturated with salt water, with astonishingly satisfactory results.

As now used, the test consists in exposing the articles in any convenient chamber into which there is projected an atomized spray of water saturated with common salt in solution, care being taken to avoid placing the test specimens directly in the path of the jet. To insure constant saturation, an excess of salt is kept in the water at the bottom of the chamber. The spray is produced by a

jet of compressed air lifting the water to the nozzle, whence it is projected as a cloud. This apparatus is the common atomizer, so-called, used in the household. The chamber is necessarily not tightly sealed, but is open sufficiently to permit "breathing"; when used with an air jet, there is a slight pressure which is relieved through the breathing openings.

If desired, the test may be modified by the use of a fine steam jet to raise the temperature of the atmosphere in the chamber. There is also the possibility of rendering the test atmosphere slightly acid or alkaline by suitable additions to the water in substitution for the salt. For use with plain water, the closet generally used for cement testing does very well, provided care is taken that it is so arranged as to maintain the air practically at 100 per cent relative humidity. When using salt solutions, recourse must be had to the atomizing jet to insure the development of the salt fog.

When exposed as described, articles have a very thin film of moisture over their surface, but there should be very few, if any, drops of sensible size on the objects. Obviously, the test is very searching, as all parts of the surface are exposed, and any pin holes or uncovered areas become evident. This gives one an opportunity to learn something of the efficiency of any protecting process in taking care of edges, sharp corners, porous spots in the metal surface, etc. By noting the character of the final general break-down, a very good idea of the evenness of the coating applied may be obtained.

The method of test may be applied to bare metals as well as to those coated to prevent rusting. For this purpose, the plain saturated atmosphere is apt to be better than a salt atmosphere, because the latter may be too severe and hence make comparisons rather difficult.

The salt-spray test, as we have called it, has been used in the laboratory, with which the author is connected, for a number of years, and during the last four or five years it has also been used commercially as a check upon the process of sherardizing which is in use. The coated articles are exposed to the salt fog, and are examined from time to time to note their surface condition. When the coated material is iron in any of its several forms, red rust begins developing as soon as the coat breaks down. This rust may appear in small pin points which gradually extend, or it may appear generally over the surface of the article. When the coating is relatively thin and poor, rust may develop in from 2 or 3 hours to 24 hours, or longer. A better coat will last 2 or 3 days, but a well-applied coat of requisite thickness will last at least a week. If no rusting is developed in two weeks' time, it may be safely assumed that the life of the coating will be practically indefinite. These figures are based on experience with both sherardized and galvanized types of coating. Other types give results which lie in approximately the same range.

This method of testing is not offered in replacement of other methods of testing which have long been in use, especially when such tests are used solely for comparison on material treated always by the same process. It has, however, almost entirely displaced all such methods of test in our own practice, especially when comparisons are desired between processes of different character, because it is the only test which we have been able to devise which approximates practical conditions, and yet yields results within a reasonably short time. The salt spray test is only an exaggeration of what may be expected at the seashore and differs only in degree, not in kind, from the normal conditions under which the article is intended to be used.

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